The
Small Computer
Magazine

kilobaud T.M.

Understandable for beginners . . . interesting for experts

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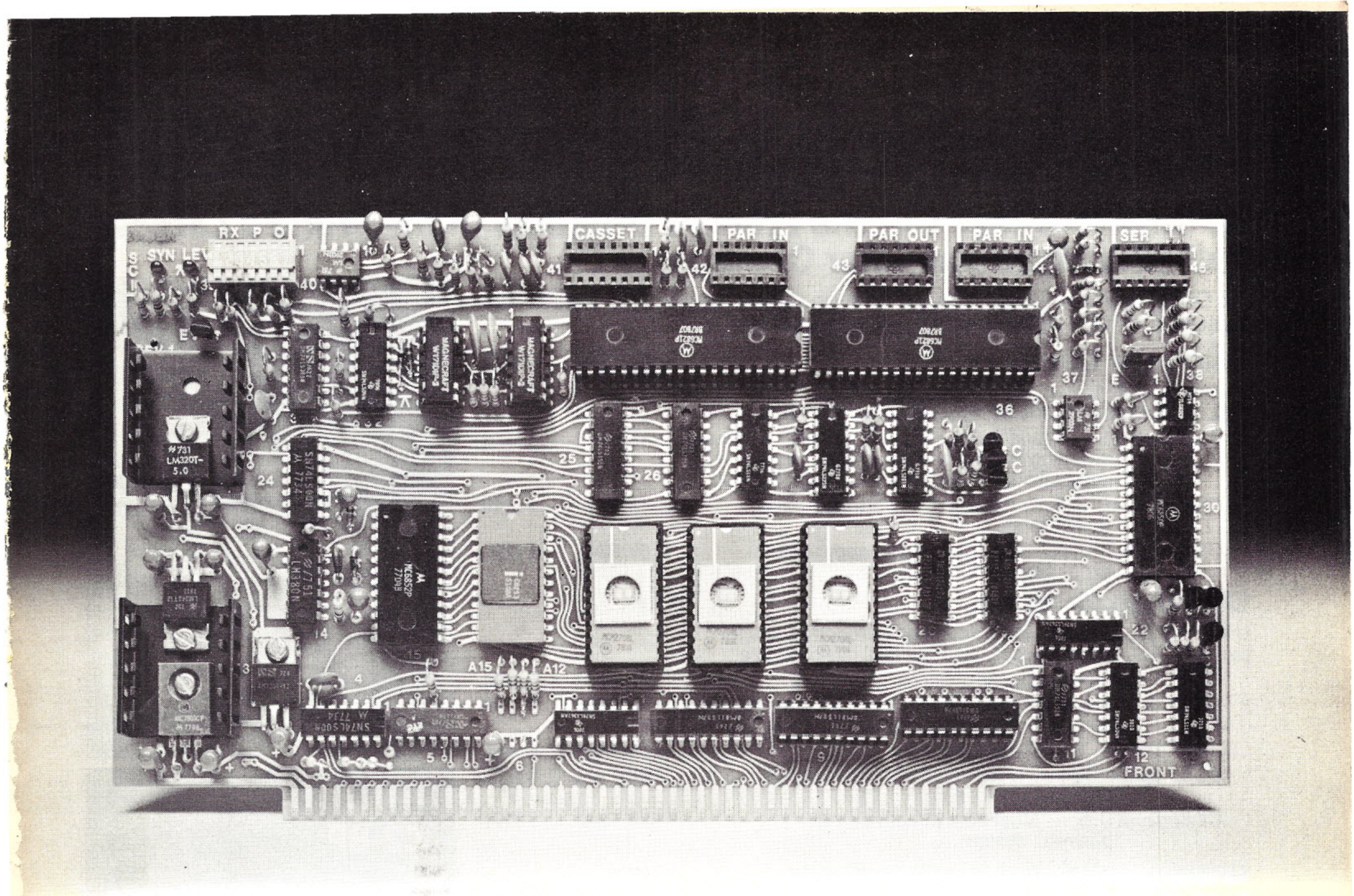

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Economical computer systems that talk in BASIC.
Ideal for hobbyists, students, education and the home.

	Minimum Configuration	Base Price
Superboard II — World's first complete system on a board including keyboard, video display, audio cassette, BASIC-in-ROM and up to 8K RAM	4K RAM	$ 279
Challenger IP — Fully packaged Superboard II with power supply	4K RAM	$ 349
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Challenger IIP Series

Ultra high performance BUS oriented microcomputers for personal, educational, research and small business use.

C2-4P — The professional portable	4K RAM	$ 598
C2-8P — The world's most expandable personal machine for business or research applications	4K RAM	$ 799
C2-4P Disk — The ultimate portable	16K RAM	$1464
C2-8P Single Disk — Ideal for education, advanced personal users, etc.	16K RAM	$1738
C2-8P Dual Disk — Most cost effective small business system	32K RAM	$2597

Challenger II Serial Interface Series

Same great features as Challenger IIP Series for those who have serial terminals: small business, education, industry.

C2-0—Great starter for users with a terminal	4K RAM	$ 298
C2-1 — Great timeshare user accessory; cuts costs by running simple BASIC programs locally	4K RAM	$ 498
C2-8S — Highly expandable serial machine, can add disks, etc.	4K RAM	$ 545

Challenger III The Ultimate in Small Computers

The unique three processor system for demanding business, education, research and industrial development applications.

C3-S1 — World's most popular 8″ floppy based microcomputer	32K RAM dual floppys	$3590
C3-OEM — Single package high volume user version of C3-S1	32K RAM dual floppys	$3590
C3-A — Rack mounted multi-user business system directly expandabe to C3-B	48K RAM dual floppys	$5090
C3-B — 74 million byte Winchester disk based system. World's most powerful microcomputer	48K RAM dual floppys	$11,090

OHIO SCIENTIFIC also offers you the broadest line of expansion accessories and the largest selection of affordable software!

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☐ Educational Systems ☐ Industrial Development Systems
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✓01

The C2-4P
The Professional Portable by Ohio Scientific

Ohio Scientific now offers you the world's most powerful portable personal computer in both BASIC-in-ROM and mini-floppy configurations.

C2-4P Mod 2 Standard Features:

- Minimally equipped with 8K BASIC-in-ROM, 4K RAM, machine code monitor, video display interface, cassette interface and keyboard with upper and lower case characters. (Video monitor and cassette recorder optional extras.)
- The fastest full feature BASIC in the microcomputer industry.
- The C2-4P Mod 2 features the most sophisticated video display in personal computing with 32 rows by 64 columns of upper case, lower case, graphics and gaming characters for an effective screen resolution of 256 by 512 elements.
- The CPU's direct screen access, coupled with its ultra-fast BASIC and high resolution, makes the C2-4P capable of spectacular video animation directly in BASIC.
- The C2-4P features computer "BUS" architecture. It internally utilizes a 4 slot backplane. Two slots are used in the base machine leaving 2 slots open for expansion.
- Comes fully assembled and tested. BASIC and machine code are always accessible immediately after powerup.
- A new high density static RAM board and two economical minifloppy options give the C2-4P tremendous expansion capability without sacrificing portability.

The C2-4P offers the user mainframe performance in a portable package. This performance makes the C2-4P suitable for use in home computing, education, scientific and industrial research and small business applications.

Other small personal computers can satisfy the requirements of the computer novice, but no other personal portable can match the C2-4P in professional and computer enthusiast applications.

Yet the C2-4P and its accessories are priced only slightly above the mass marketed "beginner" or "home" computers.

For more information, contact your local Ohio Scientific dealer or the factory at (216) 562-3101.

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The C2-8P
An exceptional value in personal computing

If you are interested in an ultra high performance personal computer which can be fully expanded to a mainframe class microcomputer system, consider the C2-8P.

Features:

- Minimally equipped with 8K BASIC-in-ROM, 4K RAM, machine code monitor, video display interface, cassette interface and keyboard with upper and lower case characters. (Video monitor and cassette recorder optional extras.)
- The fastest full feature BASIC in the microcomputer industry.
- Boasts the most sophisticated video display in personal computing with 32 rows by 64 columns of upper case, lower case, graphics and gaming elements for an effective screen resolution of 256 by 512 elements.
- The CPU's direct screen access, coupled with its ultra fast BASIC and high resolution, makes the C2-8P capable of spectacular video animation directly in BASIC.
- Fully assembled and tested: 8 slot mainframe class microcomputer, six open slots for expansion. Supports Ohio Scientific's ultra low cost dynamic RAM boards or ultra high reliability static RAMs.
- The C2-8P can support more in-case expansion than its four nearest competitors combined.
- The C2-8P is the only BASIC-in-ROM computer that can be directly expanded today to a complete business system with line printer and 8″ floppy disk drives.
- It is the only personal class computer that can be expanded to support a Hard Disk! (CD-74)

The C2-8P is the fastest in BASIC, has the most sophisticated video display and is the most internally expandable personal computer. Therefore, it should be the highest priced?

Wrong. The C2-8P is priced considerably below several models advertised in this magazine. The C2-8P is just one of several models of personal computers by Ohio Scientific, the company that first offered full feature BASIC-in-ROM personal computers.

For more information, contact your local Ohio Scientific dealer or the factory at (216) 562-3101.

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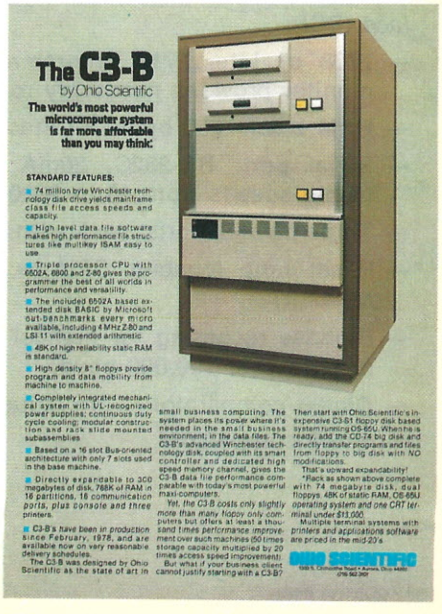


The C3-B
by Ohio Scientific

The world's most powerful microcomputer system is far more affordable than you may think.*

STANDARD FEATURES:

- 74 million byte Winchester technology disk drive yields mainframe class file access speeds and capacity.
- High level data file software makes high performance file structures like multikey ISAM easy to use.
- Triple processor CPU with 6502A, 6800 and Z-80 gives the programmer the best of all worlds in performance and versatility.
- The included 6502A based extended disk BASIC by Microsoft out-benchmarks every micro available, including 4 MHz Z-80 and LSI-11 with extended arithmetic.
- 48K of high reliability static RAM is standard.
- High density 8″ floppys provide program and data mobility from machine to machine.
- Completely integrated mechanical system with UL-recognized power supplies; continuous duty cycle cooling; modular construction and rack slide mounted subassemblies.
- Based on a 16 slot Bus-oriented architecture with only 7 slots used in the base machine.
- Directly expandable to 300 megabytes of disk, 768K of RAM in 16 partitions, 16 communication ports, plus console and three printers.
- *C3-B's have been in production since February, 1978, and are available now on very reasonable delivery schedules.*

The C3-B was designed by Ohio Scientific as the state of art in small business computing. The system places its power where it's needed in the small business environment; in the data files. The C3-B's advanced Winchester technology disk, coupled with its smart controller and dedicated high speed memory channel, gives the C3-B data file performance comparable with today's most powerful maxi-computers.

Yet, the C3-B costs only slightly more than many floppy only computers but offers at least a thousand times performance improvement over such machines (50 times storage capacity multiplied by 20 times access speed improvement).

But what if your business client cannot justify starting with a C3-B? Then start with Ohio Scientific's inexpensive C3-S1 floppy disk based system running OS-65U. When he is ready, add the CD-74 big disk and directly transfer programs and files from floppy to big disk with *NO* modifications.

That's upward expandability!

*Rack as shown above complete with 74 megabyte disk, dual floppys, 48K of static RAM, OS-65U *operating system and one CRT terminal under $11,000.*

Multiple terminal systems with printers and applications software are priced in the mid-20's.

OHIO SCIENTIFIC

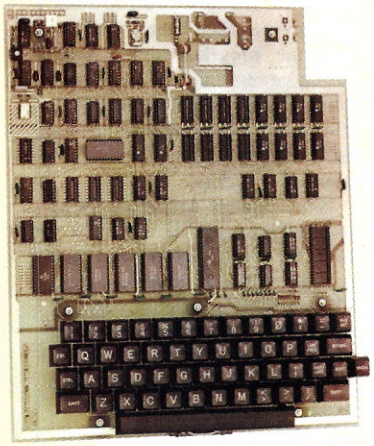
The Age of Affordable Personal Computing Has Finally Arrived.

Ohio Scientific has made a major breakthrough in small computer technology which dramatically reduces the cost of personal computers. By use of custom LSI micro circuits, we have managed to put a complete ultra high performance computer and all necessary interfaces, including the keyboard and power supply, on a single printed circuit board. This new computer actually has more features and higher performance than some home or personal computers that are selling today for up to $2000. It is more powerful than computer systems which cost over $20,000 in the early 1970's.

This new machine can entertain your whole family with spectacular video games and cartoons, made possible by its ultra high resolution graphics and super fast BASIC. It can help you with your personal finances and budget planning, made possible by its decimal arithmetic ability and cassette data storage capabilities. It can assist you in school or industry as an ultra powerful scientific calculator, made possible by its advanced scientific math functions and built-in "immediate" mode which allows complex problem solving without programming! This computer can actually entertain your children while it educates them in topics ranging from naming the Presidents of the United States to tutoring trigonometry all possible by its fast extended BASIC, graphics and data storage ability.

The machine can be economically expanded to assist in your business, remotely control your home, communicate with other computers and perform many other tasks via the broadest line of expansion accessories in the microcomputer industry.

This machine is super easy to use because it communicates naturally in BASIC, an English-like programming language. So you can easily instruct it or program it to do whatever you want, *but you don't have to.* You don't because it comes with a complete software library on cassette including programs for each application stated above. Ohio Scientific also offers you hundreds of inexpensive programs on ready-to-run cassettes. Program it yourself or just enjoy it; the choice is yours.



Ohio Scientific offers you this remarkable new computer two ways.

Challenger 1P $349
Fully packaged with power supply. Just plug in a video monitor or TV through an RF converter to be up and running.

Superboard II $279
For electronic buffs. Fully assembled and tested. Requires +5V. at 3 Amps and a video monitor or TV with RF converter to be up and running.

Standard Features

- Uses the ultra powerful 6502 microprocessor
- 8K Microsoft BASIC-in-ROM
  Full feature BASIC runs faster than currently available personal computers and all 8080-based business computers.
- 4K static RAM on board expandable to 8K
- Full 53-key keyboard with upper/lower case and user programmability
- Kansas City standard audio cassette interface for high reliability
- Full machine code monitor and I/O utilities in ROM
- Direct access video display has 1K of dedicated memory (besides 4K user memory), features upper case, lower case, graphics and gaming characters for an effective screen resolution of up to 256 by 256 points. Normal TV's with overscan display about 24 rows of 24 characters; without overscan up to 30 X 30 characters.

Extras

- Available expander board features 24K static RAM (additional), dual mini-floppy interface, port adapter for printer and modem and an OSI 48 line expansion interface.
- Assembler/editor and extended machine code monitor available.

Interested in a bigger system? Ohio Scientific offers 15 other models of microcomputer systems ranging from single board units to 74 million byte hard disk systems.

ORDER FORM

Order direct or from your local Ohio Scientific dealer.

☐ I'm interested. Send me information on your: ✓01
☐ Personal Computers ☐ Business Systems
☐ Send me a Superboard II $279 enclosed
☐ Send me a Challenger 1P $349 enclosed
☐ Include 4 more K of RAM (8K Total) $69 more enclosed

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PUBLISHER'S REMARKS

Wayne Green

Instant Software

We spent much of this summer developing our system for publishing software. No publishing enterprise turns out to be simple, and publishing software is no exception.

The system we've gradually developed works like this: When a program is received for publication, the first step is to log it in and send a confirmation so the author will know we have it. If any of the key elements are missing—such as a cassette with the program on it or documentation that explains what the program is, what it does, and how to use it—the missing elements are requested.

The next step is to check out the program and make sure it works. This is when we compare it with what we already have on hand, watching for duplication.

Then we look over the list of associate editors for the best people to check out this type of program. We make about ten copies of the cassette and documentation and send them out. Associate editors have a week to evaluate the program and send in their recommendations . . . and any improvements they might work out.

If the vote is affirmative, the author is sent a contract and copies of the recommendations from the associate editors. When he has made the changes to the program and is sure it is debugged, we get it back for publication.

A documentation editor writes a final version of the operating instructions, has them set in type and pasted up for printing. The master editor makes the cassette or tape masters for duplication of the program on cassette. This includes adding a short introduction program which quickly confirms that the user's system is working OK . . . and possibly a second section which prints out the instructions for using the program or the rules of a game, if it is a game program.

Then comes the actual program. When this is put into master form, a byte and bit count is made; this will thereafter be checked against duplicates for quality control.

Then labels have to be designed and produced for the cassettes and the box covers for the program package, the catalog write-ups have to be done and so forth. It's a long process and it takes a lot of people to make it go smoothly and permit the production of more than one program at a time. We're aiming at eventually being able to turn out several new progams per day!

Peterborough, a town of 4500 people, is small, yet it is the hub for this part of the state . . . with a surprising number of larger businesses and shopping facilities . . . and *no* fast-food joints! Not yet, anyway.

Until we build a new plant, we are operating primarily out of our 250-year-old house in Peterborough. We do have three other locations in town, plus one in a neighboring town, for offices and storage. We'd like to get it all under one roof again.

So, rather than have a horde of programmers working here, I've planned it so most of the technical work can be done by free-lance people. Our associate editors will evaluate and improve submitted programs . . . for pay. We want to have most submitted programs rewritten to work on as many systems as possible, so this work too will be done free-lance and for a share of the royalty.

Programmers interested in working as associate editors—you should drop me a line listing your equipment and areas of expertise. Those interested in converting programs from one system to another should let me know which formats you can work with. I'll send you further details.

The end result will be to have those people working here who absolutely must be here and to have everyone else work free-lance, thus spreading out the bonanza for many to share.

Our preliminary estimate of the work involved in getting a program published runs to about $2000 . . . and that does not include the cost of the cassettes or equipment for producing them. That's just for the time it takes to go through all of the steps that will eventually bring forth the cassette, instruction booklet, box and promotions.

All this takes not only people, but room, too. We are presently expanding into our barn, covering over with plywood paneling the beams that horses gnawed a hundred years ago. Obviously we'll be needing a bigger and better building, but that takes money and time, neither of which is in bountiful supply. Will we build a standard prefab plant along with the other new plants in the area? Or will we be able to build something unusual into the side of a mountain and have it fit into the natural environment? We'll know before long.

If you look over the list of jobs that have to be done to publish a program, you'll no doubt notice that only a few of them require people with microcomputer or even software backgrounds. I originally figured we'd need a lot of programmers, but after discovering that good programmers are exceptionally difficult to find, I worked out a system that would use programming talent only where it actually was needed: at about one step of the process.

Thus, while a background in microcomputers or BASIC programming is in no way harmful, most of the jobs won't really require them. In addition to the primarily clerical jobs of getting the programs ready for publication, we will be needing good people to work at marketing, sales, advertising, promotion, accounting, packaging, shipping, management, customer service, high-speed duplicating, etc. It will be a long time before we have everyone we need, even just to get the project going full swing.

We're looking for several things in the people who work with us. First, they must be nonsmokers. Then, while background and intelligence are helpful, the most important second characteristic we need is perseverance . . . the ability to get a job done, despite the difficulties.

Why are we in New Hampshire? Well, a publishing house can be just about anywhere in the country. Most of the business is carried on by mail, UPS and phone, so the location is not of critical importance. When I looked around a few years ago to see where I wanted to locate my business I visited quite a few areas . . . and decided on southern New Hampshire. The tax situation could hardly be better . . . the climate is superb . . . no smog . . . relatively inexpensive to live . . . not too far from Boston.

Program Documentation

As more and more programs are submitted for publication as Instant Software, it becomes increasingly obvious that some guidelines for documentation are needed. Here they are:

First, we need to know what system your program is designed to be used on. If it is a TRS-80, for example, we need to know if it is Level I or II, and whether 4K or 16K memory.

It will help both in our evaluation and that of our associate editors if there is an explanation of what the program is intended to do. This may be self-evident to you, but it could confuse us. Furthermore, it doesn't hurt to point out any possible benefits to the user the program might have. Will it be entertaining? Perhaps it will save him time or money. Will it educate? Make as complete a list of the sales points for the program as you can.

Next we need to know how to use the program. If it is in sections we need to know what each section does and how to use it. The identical instructions may be made part of the program to help users get used to it, but this won't help speed acceptance of your program by our staff.

It is most helpful if you can include a list of the variables you've used and an indication of any program changes a user might find beneficial, whether to vary the difficulty of a game or to custom-fit it to different peripheral addresses. We also would like to have a byte count for the program so we can be sure it is correctly loaded for our tests. You should include an estimate of the total memory needed by the user so he won't run out of memory in the middle.

If you can provide a printout of the listing and a sample run or two, this will speed things up. It isn't absolutely necessary, but it helps.

We need a statement from you that the program is original in its coding and that it has not been published elsewhere or even submitted elsewhere for publication. We don't want to get into copyright battles . . . nor do you.

If you have any ideas for expansion of the program, let us know. We'll be farming it out to associate editors and they may come up with ideas for changes

that might otherwise net them royalties, so the more complete you make your package the better.

If you have the facilities available for providing your program in a format for any other systems, let us know. We want to put out every program in as many different formats as possible, and we will be paying the highest royalties to authors who provide a variety of formats. If you can't manage other formats, we will be looking for free-lance programmers to convert your program for a share of the royalty on the sales in that format.

Choose Your Publisher Carefully

Several programmers have recently refused buy-outs of their programs by other publishers who made offers in the $500 to $1000 range since they preferred to have us publish them. I think we will be able to do a far better job of distribution and support than anyone else . . . and once you make a choice it is not reversible. Probably the worst possible deal is submitting your program for publication in another magazine where you may get a couple hundred dollars . . . period.

Software Numbering System

Each Instant Software program has a number, followed by a letter. The letter indicates which system the cassette is formatted for. Here is the present plan, which is dependent upon the systems now on hand in the *Kilobaud* laboratory.

A	Apple II
E	Exidy (same as PT, I think) Sorcerer
H	Heath H8
I	Imsai
M	Mits Altair
O	Ohio Scientific (Kansas City 1200 baud)
P	Commodore PET
R	Radio Shack TRS-80, Levels I and II
RI	Radio Shack TRS-80, Level I only
RII	Radio Shack TRS-80, Level II only
S	Southwest Tech (Kansas City 300 baud)
T	Tarbell

The Integrated Terminal?

How long will it be before a business terminal, intended for the executive to check data, will also be used to communicate? By keeping the few extra circuits needed for television use of the monitor, it would be simple to add a two-way TV intercom to an office computer system.

This type of terminal would tie in with my concept of using video cassettes for teaching. All you would have to do would be to have a small TV camera built into the terminal to give you that option.

Until Ma Bell gets video bandwidth phone lines available, we are not likely to use two-way TV communications in many installations for long-distance conversations, but there would be no problem in grabbing a frame of the picture every few seconds and sending slow-scan television pictures along with any voice communications. This could be done using the bandwidths already available.

Cable TV has a lot of promise, but only for local activities. The cables connect facilities to local homes . . . but no further. It would take a Ma Bell-type of long-lines setup to provide the lines and switching required for any serious interstate communications. Cable TV can help local stores take orders via TV and computer . . . can open local elections to more people . . . town meetings where people can attend from home and contribute, etc.

If Ma can convert to glass and laser long lines instead of wires, she will be able to fend off any communications developments via two-way cable. If cable people could start an interconnect service that had the possibility of meeting the need, they might have a chance at the 1990s golden Cadillac. Either way, I see the post office as a loser. I see most of the mail going electronic . . . it has to.

Study To Be Made

A recent news release says the University of Southern California has gotten a grant from the National Science Foundation to study the effects of the personal computer revolution.

Ugh. More and more I am growing to dislike the use of the term "personal computer." It is vague and means so little without a follow-up definition that it annoys me. I can adjust fine to "small computers" or to "microcomputers," but what is a "personal computer"?

Well, never mind. During the next year or so the USC group is going to try to find out if these computers will raise or lower educational standards. I have a few words on that, putting on my predicting hat . . . kind of cone shaped, much like a dunce cap.

I predict that microcomputers will make possible giant strides in education. Students will be freed from poor teachers and get the best of instruction via computerized courses. These interactive courses will be put together by the best talents in the world.

Whether students will be sitting at something like a TRS-80 or a modified video cassette system remains to be seen. I favor the video approach, and I may just develop enough impact to get such an innovation accepted. I will be trying . . . unless something better comes along.

The development of data bases will help students too. How long will it be before there are services, possibly via the TV cables, that

(continued on page 19)

Reader Responsibility

One of your responsibilities, as a reader of *Kilobaud*, is to aid and abet the increasing of circulation and advertising, both of which will bring you the same benefit: a larger and even better magazine. You can help by encouraging your friends to subscribe to *Kilobaud*. Remember that subscriptions are guaranteed—money back if not delighted, so no one can lose. You can also help by tearing out one of the cards just inside the back cover and circling the replies you'd like to see: catalogs, spec sheets, etc. Advertisers put a lot of trust in these reader requests for information. To make it even more worth your while to send in the card, a drawing will be held each month and the winner will get a lifetime subscription to *Kilobaud*!

This time around, the winner of a lifetime subscription to *Kilobaud* is Robert Watt of Reseda CA. Congratulations, Bob.

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INCLUDE OLD ADDRESS AND ZIP CODE WITH ADDRESS CHANGE NOTIFICATION.

LEGAL/BUSINESS FORUM

Kenneth S. Widelitz
Attorney-at-Law

This month's Forum informs you how your Uncle Sam, not ordinarily thought of as being imbued with the Christmas spirit, can provide you with a little "Christmas gift."

* * *

How would you like a 15 percent (or more) discount on all your computer purchases? Uncle Sam, care of the Internal Revenue Service (IRS), is willing to give it to you. The IRS has gone so far as to set out rules, regulations and procedures for obtaining the subsidy. In order to get it, all you have to do is use your computer in an activity the IRS determines is engaged in for profit (a business), as opposed to an activity not engaged in for a profit (a hobby).

There are three distinct areas in which the IRS will allow you a "rebate" on the purchase of your computer equipment. Two of them are directly tied to the purchase price and life expectancy of the computer equipment itself. The third area is related to the expenses you may deduct in running your activity engaged in for profit, deductions that could otherwise not be taken. First I will describe the subsidies available and then tell you how to obtain them.

Investment Tax Credit and Depreciation

If you do use your computer in an activity that the IRS agrees is one engaged in for profit, you will be allowed an investment tax credit equal to 10 percent of your investment in your microcomputer, peripherals, accessories and other capital assets you have used in the activity. The investment tax credit is about as close to a rebate as you can come. Next April, after you have determined the amount of tax that you owe to the government, but before you painfully write out the check, subtract an amount equal to 10 percent of the purchase price of the equipment.

The theory behind the investment tax credit is that it encourages investment. Since you were going to buy your computer anyway, you really don't need that much incentive. However, you can take those savings and buy yourself a few more boards (which will generate more investment tax credit).

The investment tax credit can only be taken in the tax year in which the equipment is purchased. Furthermore, in order for you to qualify for the full 10 percent investment tax credit, the equipment must have a useful life of seven or more years. A seven-year useful life for a microcomputer and peripherals is reasonable and falls within the asset depreciation range guidelines for useful lives established by the IRS.

If the asset has a useful life of more than three years but less than five years, only one-third of full credit is allowed. Two-thirds of full credit is allowed if the life of the asset is more than five years but less than seven years.

The other "rebate" tied directly to the price of the equipment purchased is the benefit obtained from depreciating your microcomputer and peripherals. The simplest way to view depreciation is as a theoretical slush fund you stash away year by year to replace your computer once it wears out. Of course, as a practical matter, with the proper repair and maintenance, the computer may last longer than you do. As with many situations, the IRS does not look at practicalities. There is also no requirement that you actually stash the slush-fund money in the bank.

In order to show you how depreciation works, let's assume that you purchased your microcomputer and peripherals for $8000. You must depreciate the equipment over the same useful life that you chose for use in computing the investment tax credit. Since you will want the maximum investment tax credit, let's assume a seven-year life for purposes of depreciation. We will further assume that at the end of seven years the equipment will have a salvage value of $1000; that is, in 1985 your best estimate is that you could sell your computer for $1000.

Depreciation is calculated by subtracting the salvage value from the purchase price and dividing by the useful life. In our example, you will be able to take $1000 of depreciation a year ($8000 purchase price − $1000 salvage value = $7000 divided by 7 years equals $1000 depreciation per year). The foregoing calculation is based upon the straight-line method of depreciation. There are other methods available, some of which will give greater depreciation in the earlier years of an asset's life.

The $1000-per-year depreciation is subtracted from gross income as an expense in order to determine what the taxable income is, as opposed to the investment tax credit, which is subtracted from the tax liability once it is determined. The dollar benefit you get from depreciation is tied to your tax bracket. That is, if you are in the 50 percent tax bracket and have depreciation of $1000, you will get an actual cashflow benefit of $500. If you are in the 25 percent tax bracket, the benefit is $250, which represents an additional 3 percent "rebate" per year. Remember that you get the depreciation benefit every year for seven years.

Other Expenses

If you are engaged in an activity for profit, you can write off some further expenses that you couldn't otherwise deduct. For instance, it is very important that you be up to date and knowledgeable about the latest happenings in the personal computing industry so as to keep your activity engaged in for profit from becoming obsolete.

To keep up to date, it is necessary to subscribe to many trade journals, such as *Kilobaud*. It is also necessary to keep your customers happy. You may wish to do this by taking them to dinner at an expensive restaurant or by taking that infamous three-martini lunch.

If you operate your business out of a portion of your residence, it is possible to deduct a pro rata portion of your residence expenses. The IRS has tightened up its rules about deducting a portion of residence expenses. It is now required that the portion of the residence used in the business be used regularly and exclusively for that activity. For instance, if you live in a four-room apartment and use the den for your business, you could deduct one-quarter of your rent, electricity, gas, etc. But if the computer is in the den and the kids use it in the evening to play Star Trek, then that room is not used exclusively for the business, and the deduction would be lost.

You may also deduct expenses for supplies such as paper, ribbons, printwheels, etc.

When Is an Activity Engaged In for Profit?

It has always seemed to me that the Internal Revenue Code (IRC) reads like a Faulkner novel; the sentences go on for pages at a time. An exception to my observation is found in Section 183 of the IRC, which defines a "hobby activity" very tersely. Actually, there is no specific reference to a "hobby." Essentially, Section 183 defines an activity engaged in for profit as one other than an activity not engaged in for profit. Not much help.

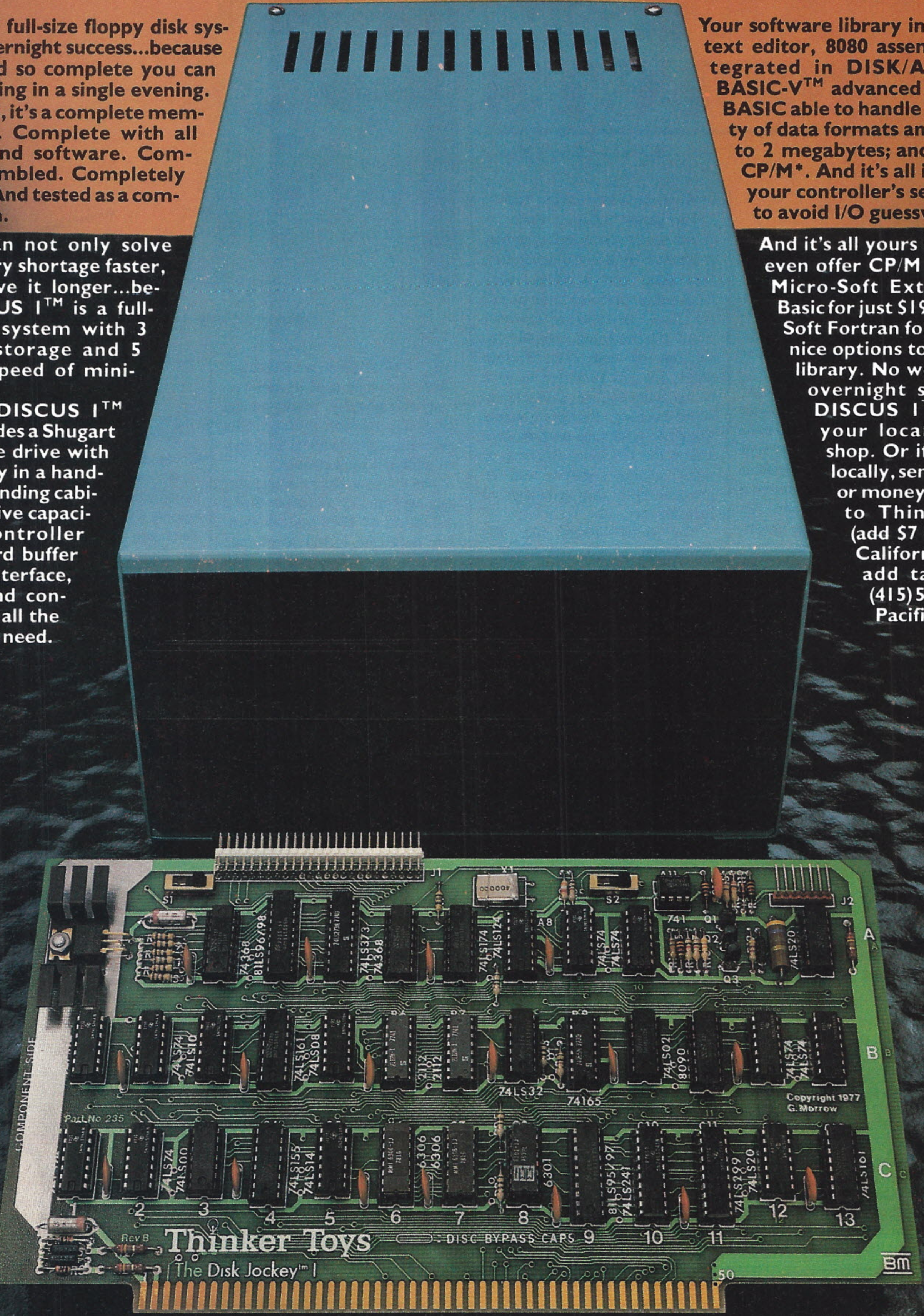
Section 183 does provide a solution to the dilemma that it created. The section provides a presumption which says that if you can make money in the activity in any two out of five consecutive years, you are presumed to be engaged in an activity for profit. Of course, there is a catch. In order to see if you have qualified under the presumption, you have to look over your shoulder using the present tax year as the fifth year. Since the entire microcomputer industry is only three years old, it would appear that the presumption would be useless.

The IRS recognized such a possibility might exist and created a mechanism that allows a new business to use the presumption. You may elect to postpone determination as to qualification under the presumption until the end of the fifth year. If you make the election you take the investment tax credit and other deductions as if you will qualify under the presumption. At the end of five years the IRS then looks to see if, in fact, you did qualify. If it is determined that you did not meet the presumption, you may then be assessed for back taxes for the previous five years.

To elect to postpone the determination you must file Form 5212, Election to Postpone De-

(continued on page 20)

FULL SIZE FLOPPY DISK $995 COMPLETE!



DISCUS I™ full-size floppy disk system is an overnight success...because it's delivered so complete you can have it running in a single evening. For just $995, it's a complete memory system. Complete with all hardware and software. Completely assembled. Completely interfaced. And tested as a complete system.

And you can not only solve your memory shortage faster, you can solve it longer...because DISCUS I™ is a full-size floppy system with 3 times the storage and 5 times the speed of mini-floppies.

Your $995 DISCUS I™ system includes a Shugart 800R full-size drive with power supply in a handsome freestanding cabinet, our 8-drive capacity S-100 controller with on-board buffer and serial interface, all cables and connectors, and all the software you need.

Your software library includes DOS, text editor, 8080 assembler (all integrated in DISK/ATE™); our BASIC-V™ advanced virtual disk BASIC able to handle a wide variety of data formats and address up to 2 megabytes; and patches for CP/M*. And it's all interfaced to your controller's serial I/O port to avoid I/O guesswork.

And it's all yours for $995. We even offer CP/M for just $70, Micro-Soft Extended Disk Basic for just $199 and Micro-Soft Fortran for just $349 as nice options to add to your library. No wonder it's an overnight success! See DISCUS I™ today at your local computer shop. Or if unavailable locally, send your check or money order direct to Thinker Toys™ (add $7 for handling; California residents add tax.) Or call (415) 524-5317, 10-5 Pacific Time.

*CP/M is a trademark of Digital Research.

A product of Morrow's
Micro-Stuff for

Thinker Toys

1201 10th Street
Berkeley, CA 94710

NEW PRODUCTS

Edited by Dennis Brisson

Library 100

The Library 100 is a collection of 100 programs, on five cassettes, for the Level II TRS-80. Cassettes are furnished in a notebook-size binder, complete with all necessary instructional documentation.

Fig. 1 shows the 100 programs, designed to be a basic computer library for the hobbyist, parent or businessman. The business and finance programs do exactly what they say they will do and present a well-designed response on the screen. All but one of the graphics are moving, not static.

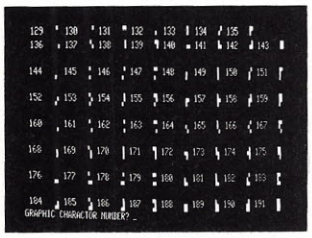
The education section is designed for use by all ages. Addition and subtraction programs have entries from right to left, just as you enter them with your pencil.

In the home section are 15 programs useful in almost any home. The Nutrition program allows calculation of calories and carbohydrates on a per-serving basis.

The games section, which includes arcade-type action games, is headed by a third-generation Star Trek and a game called Doomsday, destined to be one of the classics of computer games.

All 100 programs cost $49.50. On top of that, The Bottom Shelf, Inc., is throwing in as a bonus, Tiny PILOT, a truly interactive language that is extremely simple to learn and outputs programs for teaching, learning or sales training. Anyone can be programming this language in just minutes.

The Bottom Shelf, Inc., PO Box 49104, Atlanta GA 30359.



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129     130     131     132     133     134     135
136     137     138     139     140     141     142     143

144     145     146     147     148     149     150     151

152     153     154     155     156     157     158     159

160     161     162     163     164     165     166     167

168     169     170     171     172     173     174     175

176     177     178     179     180     181     182     183

184     185     186     187     188     189     190     191
GRAPHIC CHARACTOR NUMBER? _
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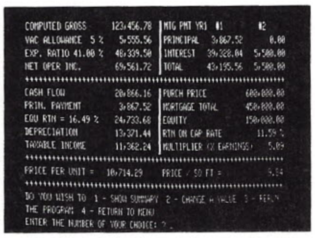
Graphics map from the draw routine.



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COMPUTED GROSS       123,456.78 |MTG PMT YR1  #1          #2
VAC ALLOWANCE  5 %     5,555.56 |PRINCIPAL   3,867.52     0.00
EXP. RATIO 41.00 %    48,339.50 |INTEREST   39,328.04  5,500.00
NET OPER INC.         69,561.72 |TOTAL      43,195.56  5,500.00
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
CASH FLOW             20,866.16 |PURCH PRICE          600,000.00
PRIN. PAYMENT          3,867.52 |MORTGAGE TOTAL       450,000.00
EQU RTN = 16.49 %     24,733.68 |EQUITY               150,000.00
DEPRECIATION          13,371.44 |RTN ON CAP RATE          11.59 %
TAXABLE INCOME        11,362.24 |MULTIPLIER (X EARNINGS)    5.09
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
PRICE PER UNIT =   10,714.29    PRICE / SQ FT =            9.94
++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
DO YOU WISH TO  1 - SHOW SUMMARY  2 - CHANGE A VALUE  3 - RERUN
THE PROGRAM  4 - RETURN TO MENU
ENTER THE NUMBER OF YOUR CHOICE: ? _
```

Example of real estate capital investment from Library 100.

Finance: Present Value of a Future Sum—Simple Interest for Days— Future Value of a Present Sum—Amortization Schedule—Interest Rate: Compound Interest—Interest Rate: Installment Loan—Days Between Dates—Term of an Installment Loan—Present Value of a Series of Payments—Real Estate Capital Investment—Nominal and Effective Interest Rates—Internal Rate of Return—Future Value of Regular Deposits—Regular Deposits for Future Value—Depreciation Amount: Rate; Salvage Value; Schedule—Bond Present Value—Bond Yield to Maturity—Sale—Cost—Margin—Day of the Week—Moving Ad.

Education: Multiplication & Division—Add—Subtract—Fraction & Decimal—States & Capitals—States & Order of Entry—States & Abbreviation—Inventors & Inventions—World Capitals & Countries—Urban Areas & Population—Authors & Books—Presidents & Order—States & Largest City—Basenum.

Graphics: Left Right—Random Ad—Graphic—Blocks—Fireside— Snow—Step Ad—Step Ad 2—Launch—Ratrace—War Game—Weird—Herring—Blinker—Snoopy.

Home: Message Board—Expense Account—Nutrition—Mileage— Remember—Phone Codes—Night Check Off—Drunkometer—Perpetual Calendar—Babysitter—Calculator—Bartender—Christmas List—Vacation Check Off—Conversion.

Games: Speedy—Odd One—R. Roulette—Star Blazer—Search— Spyship—Tiger Shark—Jumble 2—Sting Ray—Stars—Sketch—Flipper—Scissors—Horse—Doomsday—Craps—Jumble 1—Mem. Quiz Letters—Mem. Quiz Numbers—Wheel of Fortune—Decision—Unjumble—Fifteen—Towers—Life—Star Trek—Race Track—Count—Roachrace—Gypsy.

Fig. 1. 100 programs from The Bottom Shelf.

The DIGI-KIT-IZER

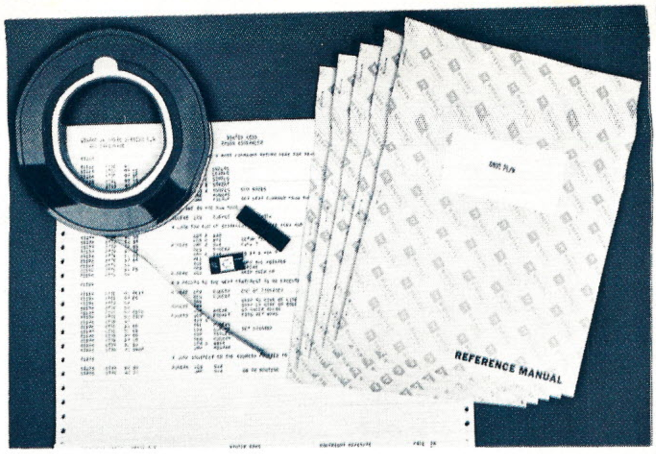
The DIGI-KIT-IZER computer input peripheral opens the door to the world of graphics for the small systems owner. Designed to be assembled by the user, the DIGI-KIT-IZER in a kit sells for $449. It can be used in architecture, cartography, mathematical analysis, motion-picture film generation and medical and dental analysis, for example.

The digitizer has an active surface area of 11 × 11 inches and a resolution of 200 lines per inch. The data rate is 100 coordinate pairs per second, and it is switch selectable from point to continuous operating modes. The transducer is a pen-type stylus, and the DIGI-KIT-IZER never needs alignment or calibration.

The utility of the DIGI-KIT-IZER is enhanced by an RS-232 option with selectable baud rates and a hi-resolution Apple interface add-on board.

Talos Systems, Inc., 7419 E. Helm Drive, Scottsdale AZ 85260.

Talos digitizer.

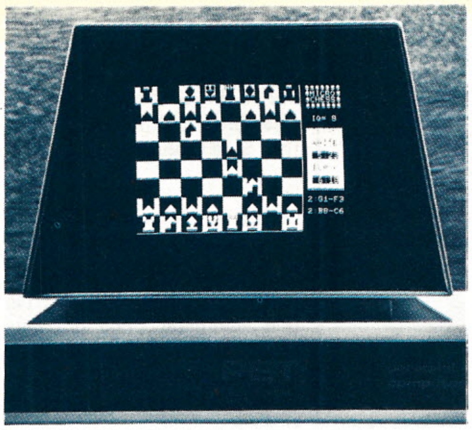


Wintek's Cross-Assembler.

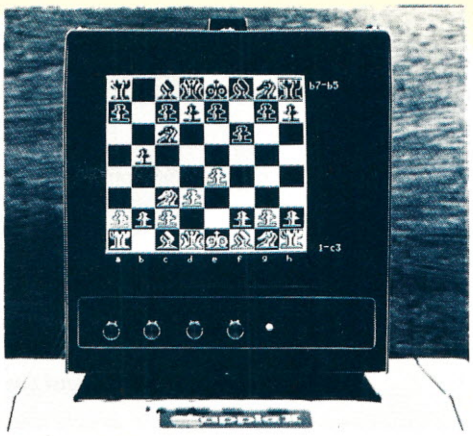
6800/6801/6802 Cross-Assembler

Version 1.4 of Wintek's 6800 Cross-Assembler supports the ten new instructions for the Motorola 6801, thus allowing assembly of programs for the 6800, 6801 and 6802. It recognizes all the standard Motorola operation mnemonics and pseudo-ops and produces a sorted symbol table and cross-reference map.

The Cross-Assembler can be used as a stand-alone assembler producing absolute object code in Motorola's MIKBUG format or in the relocatable mode for use with Wintek's Cross-Linker and PL/W compiler. By using the relocatable mode, the programmer may assemble his program in easily managed pieces and devel-



Microchess on the PET.



Microchess on the Apple.

op subroutine libraries which are then combined as needed by the Cross-Linker into a single program. Advanced listing controls, including title, subtitle, date, time, paging and spacing, and automatic formatting of the source program help improve readability and documentation for later maintenance.

The Wintek 6800 Cross-Assembler is written in ANSI Standard X3.9-1966 FORTRAN and is available for any computer or minicomputer supporting an ANSI FORTRAN compiler. The source is available on magnetic tape for $800. Also available are the Cross-Linker ($400), Simulator ($800), PL/W compiler ($1400) and Floating-Point Arithmetic/Scientific Function library ($500). The complete package is available for $3400.

Wintek Corporation, 902 North Ninth Street, Lafayette IN 47904.

WHATSIT Can Tell You

Want to index your investment portfolio, computerize your customer list or organize professional files? WHATSIT can do it, as well as many other chores that demand quick access and easy updating of disk files.

What is WHATSIT? It is a self-indexing query system now available in a CP/M-compatible model. Capable of storing up to 25,000 free-format entries, the system typically responds to queries in 4 to 15 seconds, slightly longer for updates. Automatic cross-indexing makes all entries accessible by a variety of conversational query requests, which may be as simple as: "When's Dr. Jekyll's appointment?"

Subtitled "Wow! How'd All That Stuff Get In There?" WHATSIT, unlike many systems, imposes no predetermined categories or rigid formats. The data structure evolves through normal use of the system by incorporating index "headings" chosen by the user. Entries may be cross-indexed under any number of headings, and whenever new headings are needed, they can be added in a matter of seconds.

Using a new "stretch" request, an on-line data base can be expanded as desired from one 8-inch floppy disk to as many as four. WHATSIT automatically wraps data over all available disk space . . . up to one megabyte using four single-density drives.

Data can be stored in a single master data base, if desired . . . or any number of separate data bases can be created, each indentified by name. A "reload" request makes it easy to switch, if necessary, from one data base to another. Entries may be as short as a single character or as long as 200 characters, and entries of any length may be freely intermixed without waste of disk space; WHATSIT automatically stores each entry in the smallest possible space.

The Model CP-1 runs in CBASIC and requires a minimum 40K CP/M system with one to four single-density disk drives. The system supports a printer if desired. The list price of $125 includes a 120-page manual.

Information Unlimited, 331 West 75th Place, Suite 2I, Merrillville IN 46410.

Microchess for Apple and PET

Now Apple and PET owners can play chess, too. Microchess 2.0 for 8K PETs and 16K Apples, in 6502 machine language, offers eight levels of play to suit everyone from the beginner to the serious player.

At its highest level, the program plays an extremely good game of chess and will beat most average players and many other chess-playing programs. It examines positions as many as six moves ahead and includes a chess clock for tournament play.

Microchess checks every move for legality and displays the current position on a graphic chessboard. You can play white or black, set up and play from special board positions or even watch the computer play against itself. The program is available at an introductory price of $19.95.

Personal Software, PO Box 136, Cambridge MA 02138.

TRS-80 Expandable Interface

The TRS-80 owner can now expand his computer system with a series of low-cost peripheral cards. The basic interface unit uses low-power Schottky circuitry, the standard Radio-Shack 40-pin bus, and provides the following features:

- Joysticks—two unique 8-directional hand controllers for games, screen-editing and educational instruction.
- Stereo sound—using two RCA 1863 programmable ICs.
- Parallel printer interface—with solder-free line selection.

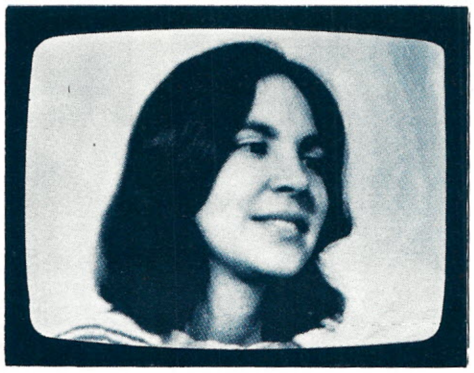
At an introductory price of $129.95, the interface may be ordered with a $29.95 optional real-time clock providing hours, minutes and seconds in memory. Joysticks and music may be controlled directly from the user's BASIC program using the INP and OUT commands.

Microtronix, PO Box Q, Philadelphia PA 19105.

Real-Time Video Digitizer

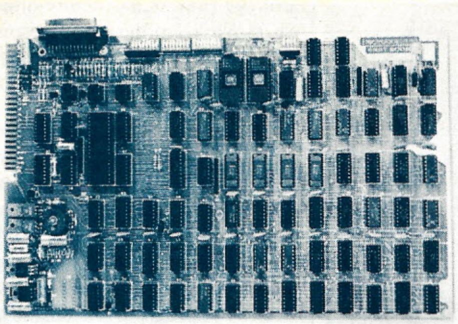
Video digitization from standard TV cameras in real time (1/60th sec/frame) can be accomplished using the Environmental

IU's query system for CP/M.

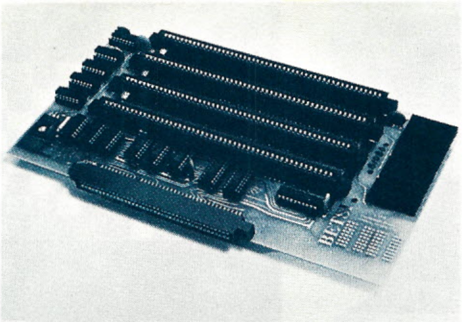


Video digitization display.

Microtronix TRS-80 interface.



Electrolabs ESAT 200B.



The Betsi board.

Interfaces Real-Time Video Digitizer. This interface can be used for computer portraits, surveillance, robotics, inventory control, pattern recognition and data transmission over phone lines for interoffice or intercity communications when combined with a modem.

The digitized picture is placed in the computer main memory via the S-100 bus (Imsai/Altair/Poly) as a single operation using direct memory access (DMA). Using the Environmental Interfaces Gray Level/Digital Monitor Interface, the digitized picture can be displayed on a monitor simultaneously with the digitized picture being placed into computer memory providing the ability to view *digital motion pictures,* or a frozen picture.

Horizontal resolution can be 64, 128, 256 or 512 picture elements (pixels) per line and is easily varied using a DIP switch; vertical resolution is also easily varied using a DIP switch. A full frame (approximately 256 lines) can be digitized, or every second, third or fourth line of any frame can be digitized reducing memory requirements. The end of the frame can be chosen at any point. The maximum resolution is 512 pixels/line X 256 lines. Each pixel is encoded in 16 gray levels (4 bits/pixel).

An important feature of the video digitizer is that there are no errors in vertical alignment. A contrast control is also available on the board. The Real-Time Video Digitizer sells for $595 fully assembled and tested with complete hardware and source code software documentation. A combined Real-Time and Monitor Interface can be purchased for $850.

Environmental Interfaces, 23414 Greenlawn Ave., Cleveland OH 44122.

The ESAT Interface Terminal

A new concept in standard interface terminals has been announced by Electrolabs, PO Box 6721, Stanford CA 94305. The ESAT 200B is a single board 80 × 24 terminal and features user-alterable EPROMs to contain two fonts of up to 128 characters each. The ESAT 200B also features split speed serial data transmission and reception, RS-232C, 20 mA loop and TTL interface levels.

The user alterable fonts are programmed into 256 7 × 8 cells, which are displayed contiguously. This allows the rendition of extended characters in two or more adjacent cells. Anything may be programmed into these character cells including Middle Eastern alphabets, APL characters and limited graphics. If the user has no EPROM programmer, he may simply pencil in the spaces in a printed grid and return it and a check for $50 to Electrolabs. Electrolabs will send him a new EPROM 2708 programmed to display the contents of his character cells exactly as he has drawn them.

The ESAT 200B comes with one 2708 containing full upper and lowercase ASCII and one empty socket where a second EPROM may be simply plugged in. In all cases, the second font is addressed using the eighth data bit, or the 'Meta' key as it is called in some systems. The ESAT 200B also presents the usual features of a terminal such as addressable, nondestructive cursor, page transmit and 15 Watts power consumption. Keyboard input is 7 or 8 bits with negative strobe, and video output is selectable RS170 composite video, or separate horizontal and vertical drive. Price is $329.

S-100 Expansion for PET

Forethought Products, PO Box 8066, Coburg OR 97401, announces a real solution to your PET expansion problems. Betsi, the PET-to-S-100 interface/motherboard, is a single-circuit board that contains all the necessary logic to interface S-100-type boards to the PET.

Unlike other interfaces that require the addition of external chassis, S-100 backplanes or special cable assemblies, Betsi attaches directly to PET's memory expansion connector and provides both interface logic and four S-100 slots on a single, compact circuit board. The board operates with any S-100 power supply and doesn't interfere with the use of PET's parallel or IEEE ports.

With the use of Betsi's on-board dynamic memory controller, which allows PET/Betsi to use the S. D. Sales "Expandoram" memory board, PET's memory can be expanded to the limit (32K) with a single S-100 card.

On-board features include sockets and decoding circuitry for 8K of PROM memory (2716). All parts and full documentation are included at $119 kit (includes one S-100 connector) and $165 assembled and tested (includes four S-100 connectors).

Cassette Controller Interface

A cassette controller interface that eliminates "pull plug-push plug" cassette-to-computer-loading-and-saving annoyances has recently been announced by Picotron.

The Model CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Speaker volume is reduced when in data search mode to allow easy listening. Normal volume is maintained when in data load mode. "Saving" data on tape can also be monitored on most recorders.

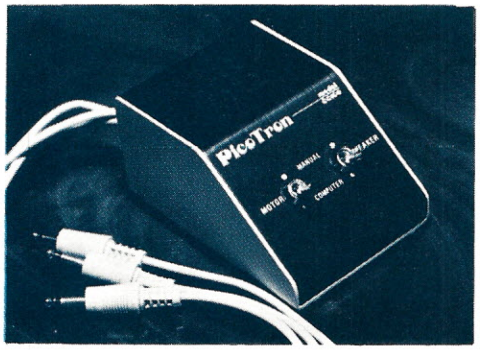
The unit features a standard cassette plug/jack interface to any computer system requiring remote control of cassette functions and is in use immediately.

The CC100 has all metal construction with black and silver anodized finish. The price is $29.50 (California residents, add 6 percent tax).

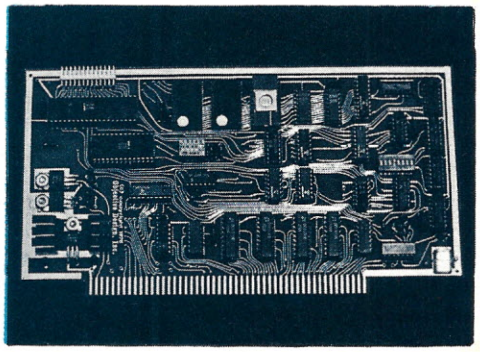
Picotron, PO Box 62076, Sunnyvale CA 94088.

Multitasks for Your Computer

S-100 computers can now handle simultaneous problems with the Multitasker, an interrupt-handling board from Objective Design, Inc., PO Box 20325, Tallahassee FL 32304. Having interrupts in the system allows one computer to do the work of many. For example, with an interrupt-driven system you can: handle program development on several terminals at once; run household appliances and play games at the same time; and con-



The Model CC100.



The Multitasker.

tinue using the computer while a slow printer is churning out a listing.

Unlike less sophisticated interrupt boards, the Multitasker does not use forced "RESTART" instructions, which tie up the near-zero address space. It can be located anywhere in memory and will generate "CALL" vectors to any location. The complex assembly-language software required for handling interrupts is available on PROM (which goes into space provided on the board), making the interface a high level, relatively easy job.

Another Multitasker board option is a crystal-derived real-time clock. Timed interrupt intervals are hardware selectable from 100 microseconds to 100 milliseconds. Software counters can extend this time into days or years. Multitasker without PROM in kit form is $205.95.

Alpha Micro Disk System

The model AM-500, an S-100-bus-compatible 10-megabyte disk system, is a compatible subsystem that consists of a single board controller, interconnect cable and disk drive. The disk drive is the popular 10-megabyte Control Data Corporation "Hawk," which utilizes a 5-megabyte fixed disk and 5-megabyte removable cartridge. The controller board is interrupt driven, requires a simple interface to the CPU operating system and does complete 512-byte transfers.

Because of the large storage capacity, the AM-500 permits huge quantities of information to be stored in a single device, readily available for quick access. Although the AM-500 was designed to work with the AMOS operating system, it may be purchased as a stand-alone and used with other operating systems on the S-100 bus.

Available in choice of rack mount or stand-alone cabinet configurations, the AM-500 comes complete with manuals and installation instructions. The unit price is $7995.

Alpha Micro, 17881 Sky Park North, Irvine CA 92714.

Hardware and Software Catalog

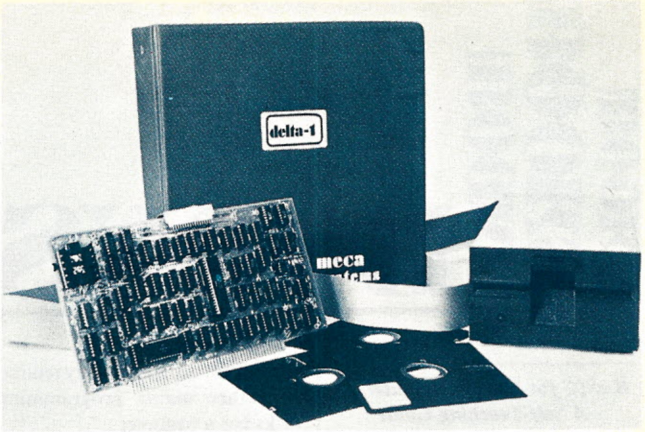
The 1978 Computerlogue has just been published by Computer Enterprises.

Subtitled "A Catalogue Of Microcomputer Hardware & Software," the Computerlogue contains 44 pages of product listings, photographs, illustrations and prices. Prices come in three categories: retail, credit card and cash discount. A handy guide to the catalog's features and two simplified order forms are included.

The catalog is available from Computer Enterprises, PO Box 71, Fayetteville NY 13066.

Delta-1 from Meca

Delta-1 is a compact disk system that incorporates Meca's MFM Disk Controller for up to 200K bytes of storage on a single mini-floppy disk. The double-density mini-floppy disk storage system takes only one half the space that a full-sized drive requires and still provides a higher storage capacity than other mini-floppy disk drives. In addition, the Delta-1 offers the capability of an integrated disk and tape storage system for users of the Alpha-1 Mass Storage System.



The Delta-1 Disk System.

The Delta-1 is supplied complete with the Meca Disk Operating System on diskette, S-100 bus compatible MFM Controller, mini-floppy disk drive, power supply, cable and connectors and full documentation for connection and operation.

Additional software for use with the Delta-1 includes CP/M Disk Operating System, Microsoft Disk BASIC and several applications software packages. The single drive system is $699 assembled; dual drive is $1149; triple drive is $1599.

Meca, PO Box 696, 7026 Old Woman's Spring Road, Yucca Valley CA 92284.

Interface Unit for TRS-80

The Telesis VAR-80 was designed specifically for the Radio Shack TRS-80 (Level II BASIC) owner. Many new microprocessor applications, such as the TRS-80 as a digital lock with the VAR-80 and an external keyboard, are possible.

The VAR-80 mates directly with the TRS-80 by connecting its compatible 40-pin edge connector via the expansion port or the screen printer port on the TRS-80. It can be used with or without the TRS-80 expansion interface unit.

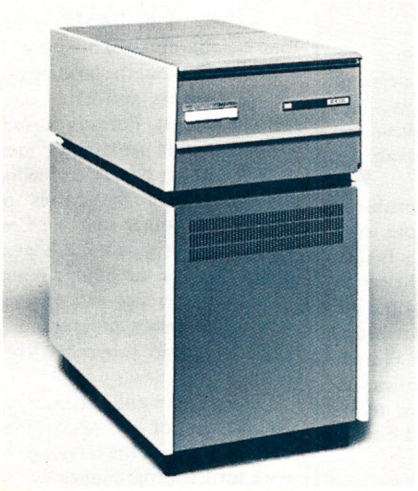
The VAR-80 provides eight inputs (two are opto-isolated and six are TTL-compatible) and eight outputs (two relays rated 110 V @ 3 Amps and six TTL). The unit comes completely assembled, fully tested and with 2 feet of interconnecting cable. Complete operating instructions, applications, sample programs and some sample circuits are also included. Price is $79.95 ($99.95, effective Jan. 1, 1979).

Telesis Laboratory, PO Box 1843, 41 S. Paint Street, Chillicothe OH 45601.

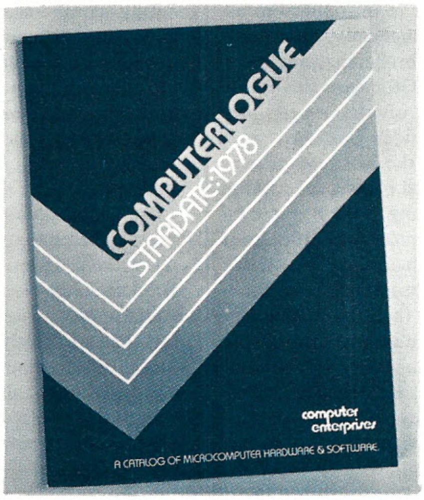
Color for the VIP

RCA has recently unveiled its

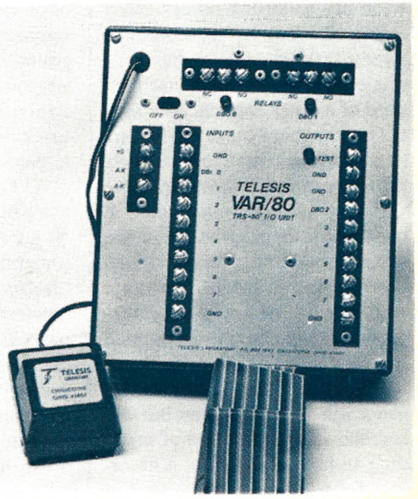
(continued on page 20)



The Model AM-500.



1978 Computerlogue.



The Telesis VAR-80.

BOOKS

BASIC for Home Computers—A Self-Teaching Guide
Albrecht, Finkel, Brown
John Wiley & Sons, $6.95

I have a problem. Every time I demonstrate my system to people, they express an interest in learning how to program. Well, maybe they play Star Trek or Star Trader or Star Wars a few times first—then they express the interest in programming. The problem is, how do I teach them? I could sit down with each and every one and give individualized lessons, but my patience is not one of my strong points, nor do I have the time to spare. What I really ought to be able to do is reach over to my trusty computer reference library, pull out a beginning BASIC manual and ask my friends to read it and return any time they want to try some of the ideas or programs.

Ah! That's stated so simply: just pull out a beginning BASIC manual and ask my friends to read it. It hasn't quite worked that way so far, mainly because there hasn't been anything I could expect my diverse friends to understand. That's not to say I haven't tried.

First there was *BASIC Programming,* then *Illustrating BASIC,* then the Radio Shack manual and a horde of others. Each has its strong points. *Illustrating BASIC,* for instance, is a handy little manual to have sitting computerside when you're in need of a quick reference for syntax or statement usage (do be sure to correct the syntax to accurately reflect your BASIC, however).

BASIC Programming has a bunch of little programs that are sometimes useful, and isn't a bad introduction to BASIC for those who have a strong math background or who have programmed in FORTRAN or other biggies.

The Radio Shack manual does a nice job as far as it goes, but still somehow lacks the kind of prodding and self-testing that is necessary for a self-learning book. For instance, even though it gives self-tests, they are not all provided with solutions and they tend to be rather major programming tasks for a beginner.

What is really needed is a self-help guide to BASIC that takes nothing for granted, provides annotated program samples, gives continuous testing and feedback to the reader, takes in the entire range of most BASICs (i.e., string variables and manipulation, two-dimensional arrays, etc.), doesn't belittle the reader or otherwise try to force humor into the situation and still manages to teach BASIC thoroughly. Sounds great, doesn't it? It does, and now I'm happy to report that it exists.

BASIC for Home Computers—A Self-Teaching Guide by Bob Albrecht, LeRoy Finkel and Jerald R. Brown (loyal computerists will recognize the names—they're sometimes referred to as the Dymax Connection) has just been published by John Wiley and Sons in their Self-Teaching Guide series.

The book is good. Written in Microsoft BASIC, it takes you from knowing almost nothing to knowing almost everything. For some, the opening chapters will be almost condescending: "We use the keyboard to type information into the computer. What happens to the information that we type? ________." But by page 45, we're introduced to assignment statements, stored programs and branching, and away we go. At 336 pages, this is certainly one of the longer self-teaching guides I've seen. It is also one of the most complete.

As I stated before, my ideal of a self-teaching guide has to have annotated programs (this book sometimes has more annotation than program), must have continuous testing (here there is hardly a page without at least one self-test question—in fact, the book is printed so that you should read it with an index card, thus covering up the answers that appear almost instantaneously after the question is asked), ought to include instructions for a complete BASIC (Microsoft BASIC is not only complete, but is fast becoming one of the standards in the software industry) and doesn't belittle the reader or force humor (*BASIC for Home Computers* seems aimed at a serious high-school student, not a bad place to aim, considering that this makes the book useful to a wide range of potential computerists).

In short, Albrecht et al have done it again—they've provided the computing community with a sensible and complete beginning guide to BASIC. I can hardly wait to try it out on my wife (just as soon as I try a couple of tricks *I* learned reading the book).

Thom Hogan
Bloomington IN

Computer Programming in BASIC for Everyone
Thomas A. Dwyer,
Michael S. Kaufman
Radio Shack, Fort Worth TX
Cat. No. 62-2015, $2.95, 156 pp.

Radio Shack has a history of rereleasing books (sometimes for prices significantly lower than the original editions). *Complete Programming in BASIC for Everyone* is a rerelease of a text first published by Houghton Mifflin, and apparently grew out of a project undertaken by Dwyer, a professor at the University of Pittsburgh, and Kaufman, a student at Harvard. The project, SOLO, dealt with computer applications in secondary-school systems. The text is an easy-to-read primer aimed at arming the novice programmer/computer enthusiast with a fundamental grasp of several BASIC key words, functions and commands.

Although the authors aimed the book at readers fortunate enough to have access to a time-sharing computer, Dwyer and Kaufman take pains to include problems and explanations that can be worked and understood off-line. Understandably, they do emphasize the obvious—that hands-on is much preferable to hands-off.

The programming problems become increasingly more difficult as the programmer's BASIC vocabulary increases. The reader is tested time and again with exercises that are merely described as word problems might be . . . emphasizing practical applications from the business sector to the realm of computer-aided instruction.

In the relatively short span of 156 pages, the authors take the beginner through a vocabulary-building exercise that familiarizes him/her with 20 key words: PRINT, END, LET, INPUT, GOTO, IF, THEN, STOP, FOR, NEXT, STEP, DIM, REM, TAB, READ, DATE, RESTORE, GOTO K OF, GOSUB and RETURN. The commands RUN, LIST, SCR, BYE, PUNCH, TAPE and KEY are explained, as are the functions WQR, INT, ABS and RND. Each definition, together with its implementation into the programming process, is explained clearly and in an understandable, but not condescending, manner.

Obviously, some of the vocabulary will differ within different versions of BASIC, but this text is worth the price, and—just for fun—some programs and problems are included with suggested methods for beginning to work with such relatively sophisticated applications as data anlysis, nonnumeric applications, games and business applications.

Risk $2.95. *Computer Programming* is worth it.

Michael Cooper
Eagle Lake TX

Introduction to BASIC
Jeffrey B. Morton
Matrix Publishers

Introduction to BASIC by Jeffrey B. Morton is written in an easy-to-follow style, making its 206 pages solid material.

Its 77 practice exercises have been thoughtfully developed, and they include more than 40 complete BASIC programs in the first nine chapters as examples or parts of the exercises. The last chapter is a 53-page section containing 12 well-chosen projects.

The book's approach places emphasis on *using* the fundamental statements in BASIC rather than bombarding the novice with every detail about the language itself (a needless and often confusing practice). For this reason, the book would probably be used most effectively by readers having already learned the basics of BASIC from other sources. Creativity and originality are promoted through the book's many and varied exercises and projects rather than fancy programming tricks and rigid program structure.

The examples and exercises are the strength of the book; they teach how to put the language *to work* for the programmer.

Randy Miller
Orem UT

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LETTERS

Article . . . Response . . . Article-Writer's Response

I am always pleased when a user takes the trouble to write an article about my Tiny BASIC because it shows that it is still a useful program, for all its limitations. Thus I was happy to see Chuck Carpenter's article in the June 1978 *Kilobaud* (p. 42).

I am disappointed, however, that he chose to publish his few criticisms before mentioning them to me.

A serious criticism is raised in his summary on page 44: "if you input more than a total of 72 characters in a single line, the program will stop. Nothing more will happen until you reset your system." This is false. A program that crashes on a user error has a bug, but Tiny BASIC does not have this particular bug. If Chuck's terminal decoded and signaled control functions such as the ASCII <BEL> (bell) code (hex 07), he would have noticed that Tiny is warning him of excessive line length by echoing bells. He could at that time either cancel the line (with control-X) and retype it, or back up a few characters (with a Shift-O, or underscore) then type in the carriage return.

Tiny has not stopped, it is only waiting patiently for Chuck to indicate what to do with this oversize input line (which, incidentally, is 75 characters, not 70). And each time he types another character to add to that line, Tiny BASIC tries (valiantly?) to let him know that it had to be discarded for lack of space. I realize the manual is not clear on the subject of oversize input lines, but it does say that excess characters are ignored and that the bell on the terminal is rung.

Tiny BASIC may still have some bugs, but in two years of operation by hundreds of users, none have been brought to my attention.

Let me suggest that if you, a user of some piece of package software (mine or anybody else's), find a problem, tell us about it first. If we fail to give you adequate service, *then* write it up in an article.

The article mentioned Tiny BASIC and the Experimenter's Kit, but did not say how to get them. Chuck could have saved many people the price of a phone call or an SASE if he had mentioned that Tiny BASIC is still $5; the Experimenter's Kit is $10 more. California residents are obliged to support the local government with 6.5 percent sales tax. If you have a KIM, please specify also whether you have added memory at 0400 or 2000.

Tom Pittman
Itty Bitty Computers
PO Box 23189
San Jose CA 95153

I had mixed emotions about responding to Mr. Pittman's letter. Therefore, at the outset, let me state that I had no intention of pointing out "bugs" in Tiny BASIC (at that time I couldn't recognize one). Nor was there any intended criticism of Tiny BASIC as an interpreter. My intent was to share my experiences using Tiny BASIC with others. It did not occur to me that my trials and tribulations could be anything more than my lack of experience with computers.

I do appreciate Mr. Pittman's response, though. One of the most difficult things I've experienced has been criticism of my efforts by others. Usually the criticism was due to ignorance. But the pride of authorship and the weeks of work put into the task made me the expert. So how could anyone intelligently criticize my work? The solution was to educate the critic.

And, in that regard, I have much respect for Mr. Pittman. He answered all my questions very patiently. Even though, looking back, the questions didn't make much sense. Therefore, I really don't understand Mr. Pittman's failure to recognize my article for what it was: a programming article written by a beginner to be shared by others.

I think it's worth noting that I did write several other programs and articles using Tiny BASIC (the one published was not the first). These included a demo program using IF-THEN-GOTO in place of FOR-NEXT, a program to plot a function, a program to do simple graphics, programs to do data processing and one on how to save memory. During this period, well over a year ago, I was learning some programming fundamentals using Tiny BASIC. I wanted to share my "discoveries."

As for the apparent (to me) line-input limitation: I still don't find anything in the Tiny BASIC user's manual that would so inform the neophyte programmer. There is, as stated, mention of oversize lines but nothing on what to do with them. The system I had then was a KIM-1 and an ACT-1 TVT. The system did not have a bell so I experienced a glitch. Here is another case where the computer documentation was not written for the beginner.

That I didn't mention where to get the Experimenter's Kit doesn't seem too important. The publisher missed it too. It does seem significant to me, however, that I did mention it and that many people were interested enough to write or call for more information. That was how I found out about Tiny BASIC. And, I don't mind a little sales pitch in a letter intended to put me in my place. But that place is still pretty much the same. I am a beginner to personal computers. I am an enthusiastic hobbyist and I intend to stay that way.

Again, let me say that I did not find problems with Tiny BASIC. In fact, I admired it and I learned a lot from using it. If, in my enthusiasm, I caused any inconvenience with my errors of omission or commission then I sincerely apologize.

Chuck Carpenter
Carrollton TX

Understandable

For me, this is an unprecedented act. I have never written a letter to a journal editor after receiving only one issue.

I had never really looked at an issue of *Kilobaud* because of its cover format. I believe I was suffering from the "four-color glossy" syndrome. As a result, I have missed out on a lot of information.

Your journal is truly understandable. The other journals I subscribe to are *Dr. Dobb's, Interface, Byte* and the IEEE journals. Both *Interface* and *Byte* seem to have abandoned the "small" system user as well as beginners, and *Dr. Dobb's* appears to be dedicated to machine languages. It was, therefore, a great relief to find a journal that had more than one article I could use and understand. It is also a pleasure to find a journal whose articles are more interesting than its ads. However, please do not eliminate the ads as they are my prime source of new-products and software information.

Carl W. Hennig
Kitchener Ontario
Canada

Variety Is the Spice of Microcomputing

While I enjoy *Kilobaud*, I must say that there appears to be a substantial difference in the levels of the articles. For example, the useful and highly informative article by Emerson Brooks, "Let Your Computer Wear a Watch," in no way compares with the rather pedantic articles "Depreciation Calculations" by John Musgrove and "Randomness is Wonderful" by Bill Rogers, all of which appeared in the October 1978 issue. These latter two articles could hardly be justified as gapfillers in The Software Vacuum.

To make a point, consider the above-mentioned article "Randomness is Wonderful." Mr. Rogers gives a program that computes a tabled histogram. While a visual inspection of the printout will give one the feeling that his pseudorandom number generator is generating a uniform distribution, it does not indicate the level of randomness, nor even uniformity. For example, the generator

$$X_0 = 0.5$$

$$X_{n+1} = \begin{cases} X_n + 1 \text{ if } X_n < 9 \\ 0.5 \text{ otherwise} \end{cases}$$

gives a (discrete) uniform distribution but would hardly be considered random. The excellent book *The Art of Computer Programming*, Vol. 2, by D. E. Knuth (Addison-Wesley, Reading MA, 1969) covers not only procedures for generating pseudorandom numbers, but also statistical tests that measure "random behavior."

On the other hand, Brooks's article gives us a useful and unique contribution that could not be found in a conventional textbook.

Instead of presenting articles that are either trite, irrelevant or merely poor presentations of information already widely known in computer science, electrical engineering, management science and other areas, why not present pedagogical articles (like the *Kilobaud* Klassroom series) on topics in these areas as they relate to the microcomputer industry?

A friend of mine once said, "I

get *Kilobaud* only for the advertisements" (he gets *Penthouse* for the articles). I wonder whether he has the right strategy. I hope not.

Gary J. Koehler

You're darn right there is a difference in the levels of Kilobaud *articles. That's how the magazine is designed. Remember, there are some* Kilobaud *readers who are having a tough time making Backgammon run properly on their TRS-80s, never mind adding real-time clocks to their systems in order to print the time and date on printouts. We want to publish articles for all our readers.*

I guess that the Rogers and Musgrove articles will be used by many more people than ever implement Brooks's interesting project. Nevertheless, as you pointed out, the Brooks article is something you'd be unlikely to find in any conventional textbook. That's the reason it was published.

On the subject of random numbers, I'd like to see a good article about them written so that nonmathematicians could understand them. If you or any of your acquaintances can undertake such an effort, let me know.

The cover of every Kilobaud *says it best: "Understandable for beginners . . . interesting for experts." That's the way we hope to keep it.—Jeff DeTray.*

Adding to "Depreciation"

Like many readers of *Kilobaud* who want to put their micros to work, I enjoyed reading the "Depreciation Calculations" article by John Musgrove (October 1978, p. 40). It is a most useful piece of work. However, there are several things about which the reader should be aware. First depreciation is not always changeable. In most cases, changing from accelerated to straight-line depreciation will not require IRS consent (Federal Tax Regulations Sec. 1.167(a)-11(c)(1)(iii)). In other instances, consent is needed (Internal Revenue Code Sec. 167(d)). It would seem advisable to consult a tax attorney or CPA.

A second caution is that Mr. Musgrove's article makes no mention of salvage value. The *Federal Tax Handbook 1977* (Prentice Hall) says: "Regardless of the method used, an asset may not be depreciated below salvage value. . . . " This may be easily inserted into Mr. Musgrove's programs with an input statement asking for the salvage value and then subtracting it from the "asset initial value" before the calculations.

A third consideration that the reader should be aware of is the number of years over which the asset may be depreciated. Guidelines, under the Class Life Asset Depreciation Range System, are given in the tax guide mentioned above.

Last, a third popular method of depreciation is the "sum-of-the-years-digits" method. Using the outlines in Mr. Musgrove's article, a program for this method of depreciation could be written using the following equation:

$$D_t = \frac{N-t+1}{2(N+1)} 2C$$

where:
D_t = depreciation in year t
N = the number of years
C = the cost of the asset

While we include complete depreciation calculations in two of our software packages, the equation above may help readers to write their own programs. Again, I advise the users of the depreciation programs to talk with a tax attorney or CPA before the often expensive "Ides of April."

Jack Purdum
Marketing Manager, ECOSOFT
PO Box 68602
Indianapolis IN 46268

To Morrow

I wish to relate to you and the readers my experience with "Thinker Toys" from George Morrow. In the past six months I bought two boards from him, the *Econoram* and the *Speakeasy*. The Econoram came assembled and has been completely trouble-free. I assembled the Speakeasy and did make a few blunders. I sent the Speakeasy back for repairs. It was returned in eight days (Missouri to California and return) and was completely functional—and no charge.

Well, I tried to hook a modem up to the Speakeasy and blew a few components. I boxed the board up and sent it back—but I included $15 for repair, since it was my mistake. Ten days later I had my board back in working condition—along with the $15. Again, no charge. It is my opinion that the Thinker Toys are the best buy for price and service. I base my opinion on experience with: Mits (which has been slow, but the quality has been good), Processor Technology (slow but good), Digital Research (fast and good), Heath (slow but good), S.D. Sales (slow and fair) and Vista (?). I will be writing later to describe the sad story with Vista.

I would like to see *Kilobaud* do a survey on the service and quality of manufacturers. This is a service you could perform for your readers! But since something like this would be very expensive, I expect you would want to reclaim some of your expenses by selling the results of the survey. I know I would pay for a report to at least have some opinions about a manufacturer before I bought $1000 worth of products from him.

Wayne Miller
Jefferson City MO

Well, Wayne, I do like to hear about firms that are outstanding as well as those that are not doing right. One of the problems involved with publishing all of the brickbats is that all too often the customer is being unreasonable, rather than the manufacturer or dealer. Of course when I get a lot of complaints, I tend to shut off advertising rights and do my best to raise hell with the firm responsible. Some are responsive, some try to ignore me. Ed Roberts of Mits once observed that it was apparent to him that it did not pay to be on the wrong side of Wayne Green. It is difficult to get on the wrong side. You have to lie to or about me. . . or obviously be cheating the Kilobaud *readers in order to win this honor.*

George Morrow, in addition to going out of his way to help his customers, is one of the most intelligent and inventive people I know. Seldom do geniuses succeed . . . all that free service may do George in, but I'm rooting for him all the way—Wayne.

Contemporary—On Time (Early, Even)

For the entire 12 months I have been learning about and evaluating which microcomputer to buy, I have been reading in *Kilobaud* and other micro magazines of the terrible delivery delays from microcomputer manufacturers—to both retail buyers and dealers.

So it was with unbelieving delight that I received delivery of my new Commodore PET from Contemporary Marketing exactly 16 days after I phoned my order to their toll-free number. When I placed my order they quoted a 2 1/2 week delivery, which I took with "a grain of salt"—but they beat even their delivery promise! Probably 4 or 5 days of that time was required for UPS transit from Illinois to a little town in Utah.

I'm grateful to Contemporary Marketing for the exceptional delivery and for using such a detailed full-page ad in the September issue of *Kilobaud*.

George K. Culbertson
Spanish Fork UT

Seeking Assistance

The Spain Rehabilitation Center at the University of Alabama Medical Center has a project underway to demonstrate both the utility and economic feasibility of the new generation of personal computers for use by the severely disabled. The programmability of the computer will allow it to serve as a general-purpose appliance to be used as an aid to communication and education as well as for environmental control and entertainment.

This system, as currently envisioned, will consist of a microcomputer; an on-line storage device for programs and data; two TV monitors for user feedback and information display; a printing device for typed output; a speech recognition device for vocal input of commands, data, and text; a power-line controller for environmental control; and a telephone dialing/answering device. We are attempting to select components that are widely distributed and serviced as well as being plug compatible and economically priced.

Programs will be written or purchased to perform specific functions in each of the four general areas mentioned above. However, we would be very interested in receiving ideas from your readers, particularly those who are disabled, those who have disabled friends or relatives, and those who have personal computers and would like to develop hardware or software for the system on their own, regarding specific functions which they would like to see developed and which could be accommodated by the proposed microcomputer system.

Charles Healey
Spain Rehabilitation Center
U.A.B. University Station
Birmingham AL 35294

Query from Down Under

I would like to hear from anyone who has done any development on HP 2649A Microprogrammable Terminal/Controller. I am interested in

developing several business applications, including a word-processing system, based on HP 2649A. The local HP representative did not find anyone who has done any work in this area in Australia yet. I would like to exchange ideas and experiences with someone who has developed some applications software, languages and/or I/O interfaces for HP 2649A. If successful, we could swap the software.

Paul Semenov
26 Heathwood St.
Heathmont
Melbourne
Australia 3135

Flex Your Finger Muscles

Apparently neither SWTP nor TSC (Technical Systems Consultants), who have written the FLEX operating system software, are interested in "sponsoring" a users' group. Understandably, they are businesses, and a users' group would be a nonprofit enterprise. It is therefore up to the users to form such a group. If you are a FLEX user, or could pass this on to someone who is, perhaps we can get such a group started.

I have written several utilities for myself that I would like to share with others. I hope that there are some others like me who have also written useful programs that they too are willing to share. Mine include: a HEX-ASCII Memory Dump Utility; a Debug Program with multiple breakpoint capability and single step; a Renumber Utility for BASIC Files that adjusts the GOTO, GOSUB and THEN statements; a couple of procedures for titling a disk; some programs in BASIC.

If you can contribute programs or are simply interested in obtaining programs for your system, please write. I'll respond to any inquiry or suggestion for starting a FLEX Users' Group.

Ronald W. Anderson
3540 Sturbridge Ct.
Ann Arbor MI 48105

From Puerto Rico

Please print this letter in your column so I might have the opportunity to meet other microcomputer fans here in Puerto Rico. I presently have two 8008s under construction, and I have used two Radio Shack TRS-80s, which are presently the only complete systems sold here.

I've heard that Mits and Imsai are starting dealerships, but they're too quiet for the open market here. If any other company is interested, please do come. I know I'm not the only one who is interested, and I know that a lot of sales can be made if that company advertises their products in our newspapers.

Keep up your good work.

Raymond J. Ramirez
Systems Engineer
PR Communications Authority
PO Box 11248
San Juan Puerto Rico 00910

Bye-Bye, Good Buddy Hello, Good Baud

I want to make a transition from CB radio to personal computers. CB is no longer the booming business it once was, and I foresee the home computer becoming very important, perhaps dominant, in the consumer electronics industry.

My background is in broadcast electronics, with considerable hobby experience in digital. I have just added a 5-foot workbench in the shop, dedicated to computer electronics.

My CB shop owns a 16K TRS-80 (Level II on order), which holds its inventory and does the roughest part of the bookkeeping. I am seriously considering the purchase of a second TRS-80 to use as a guinea pig for your WANTED! gadgets as add-ons for the '80 . . . and some ideas of my own.

I appreciate your publications . . . approve of your style . . . and find encouragement in your continual positive approach (as in the "TRASH 80")! Thank you—and your staff—for some great publications.

With a little luck on this new bench . . . look for a prototype of that TRS-80 modem before long.

Richard E. Douglas
Clewiston FL

How're You Fixed for Aphorisms?

For a revised and expanded edition of *Sconce's Razor*, the editor is soliciting aphorisms on science, technology, computing, systems theory and management. All contributions that are used will be acknowledged.

A. P. Weng
Systems Access
PO Box 4041
Louisville KY 40204

KB CLUB CALENDAR

Steve Fuller

SC/MP

"Scampus," a newsletter specializing in software, hardware mods and other stuff for the National SC/MP, is available from Tom Bohon, 2215-A Walker Drive, Omaha NE 68123.

Lansing MI

TRS-80 owners take note: The Central Michigan TRS-80 Users Group meets on the last Sunday of each month from 7-9 PM. Meetings are held in the student lounge of the Lansing Business Institute, 220 East Kalamazoo.

Call 351-0756 or write J. Gordon Williams, 5582 Coral Way, Haslett MI 48840, for more information.

Denver CO

The Denver Amateur Computer Society (DACS) now has a permanent office and meeting quarters at 1380 South Santa Fe Drive, Denver CO 80223. The club meets on the third Wednesday of each month at 7:30 PM. Further information is available from the above address or by calling club president Mike Dmytrasz at (303) 979-6441.

A special event sponsored by DACS is the Colorado Computer Corral, to be held November 11-12 at the Denver Merchandise Mart, 451 East 58th Street. The show will feature a roundup of national and regional manufacturers, distributors and retailers. Hours are 10-6 on Saturday and 12-6 on Sunday. Admission is $2.

Berlin NH

Albert Brunelli is vice-president of the Northern New England Computer Society. The club, which has a yearly membership fee of $10, holds meetings at 7 PM on the first Tuesday of each month at the New Hampshire Vocational Technical College. Direct inquiries to Albert at PO Box 69, Berlin NH 03570.

Bedford MA

December is election month for the New England Computer Society. Nominations for officers will be open at the November meeting, and the new slate will be chosen on December 6, according to the NECS Newsletter. Also in December, John Leggat of Centronics will talk about microcomputer-based printer products and processor selection criteria.

The club, now with 180 members, meets on the first Wednesday of each month. Write New England Computer Society, PO Box 198, Bedford MA 01730.

West Haven CT

Leo Taylor, secretary of the Connecticut Computer Club, sends along the following information about his group: The club meets at either the Suffield Library or the Computer Store of Windsor Locks on the first Thursday of each month. Meetings feature guest speakers, demonstrations and informal exchanges of software and hardware ideas.

Write to Leo at 18 Ridge Court West, West Haven CT 06516, for specific information on club activities.

PUBLISHER'S REMARKS

(from page 7)

will provide access to most library material, facts, data? Businesses as well as schools will need this data access. I think the selling of data will be a big business as microcomputerized educational and business systems evolve.

The student ten years from now may take home some video cassettes for the courses he is studying and do much of his learning at home. School may be more for learning physical things . . . how things are made, repaired, put together, taken apart, used. Learning to drive cars, fly planes, ride horses, swim, skindive, ski, etc., may be a part of the curriculum before long, with the present courses mostly covered by computerized instruction.

With two-way television via the cable it wouldn't be difficult for a student to let a teacher know that he had some questions. The teacher could then call the student via the cable and answer the problems, allowing one teaching expert to service students over a wide area.

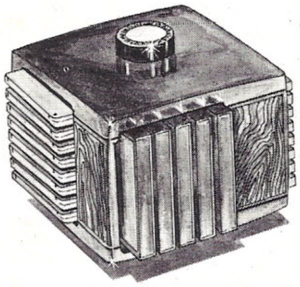
Will students learn more with such systems? I think so. When we have mass-produced educational videotapes and computer programs supporting them, we will be in show business, and learning will be a lot more fun. I have long felt that it is the responsibility of the teacher to both educate and entertain the student. If a student gets bored, that should reflect on the teacher, not the student . . . unless *everything* bores the student.

I think we will end up with fewer teachers, but better ones. Teachers will have a lot more time to develop their educations and talents, being called on to perform for videotaping of their specialties from time to time, and being supported by the proceeds of the use of their tapes and programs. This will free teachers for the physical instruction . . . and provide more funds for good school equipment. Imagine a school computer lab with an assortment of computers and sophisticated test equipment. Or perhaps restaurant chef courses to provide us with some expert cooks instead of short-order fast-food novices.

Frankly I feel that we are about to enter the most exciting epoch yet in teaching. We will have the power of television, almost unlimited money for the development of each course, top talent and the interactivity of the microcomputer to help each student along at his own pace.

I watched the teaching setup in Pago Pago with interest. Here they taught all of the children on the entire island of Samoa from one television station. It had great possibilities. Much of the value of this was lost due to the small number of students involved, which kept the budget for the TV shows at a minimum. Even worse were the union problems, which dictated that a program once broadcast had to be destroyed and not used again. What a waste! They had no contracts for residuals, so nothing was used twice.

In addition to writing about such ideas in *Kilobaud* and talking about them at computer shows, you may be sure that given the slightest chance, I'll be aiming Instant Software at expanding these ideas. I enjoy being able to have an influence on events. I haven't done much yet, but I'm in there pitching. I wonder how microcomputing might have progressed if I had not had the idea and started *Byte* and then *Kilobaud* magazines? What if I had not pushed for computer store



distribution of microcomputers back in mid-1975?

Letters from computerists who have been swept up by my writing and talks to get into the business are not unusual, so I'll keep on prodding here and there. I do wish that my Kansas City cassette standards meeting had been more productive in the long run.

The USC group wants to find out if small computers may increase or decrease employment. I doubt if they will have a strong impact on this. They certainly will take over a lot of the drudgery and make work more pleasant. They will help keep costs of running business down and result in more service or product for the consumer . . . or at least lower prices.

Those are some of my thoughts. What ideas do you have for the future?

LEGAL/BUSINESS FORUM

(from page 8)

termination, and Form 5214, Consent Extending the Period of Limitation. The first form is self-explanatory. The reason for the second form is that the statute of limitations for tax returns is three years. Since five years would have elapsed before a final determination could be made, the IRS wants to be able to get you for the first two years if you don't meet the requirements of the presumption.

Even if you fail to meet the presumption, there is still the possibility that the activity can be determined to be one engaged in for profit. In such circumstances, you negotiate with an IRS agent. There are a number of factors that are considered by the IRS in making a determination as to whether the activity is a business or hobby. For instance, if you keep businesslike books and records or if you have quit a job in order to conduct the activity, those items would be viewed by your agent as indicating a business activity. The extent to which there are elements of personal pleasure or recreation involved in the activity will be viewed negatively in making the determination.

You can see that you don't have to be very successful in order to meet the presumption. Theoretically, if you had a net income of $10 in years three and four, you would meet the presumption even if you suffered thousands of dollars of losses in the other years. Remember, however, that the presumption is merely that. The IRS can rebut the presumption even if it is met.

The presumption itself creates important tax-planning considerations. If you are contemplating purchasing a life subscription to *Kilobaud*, you might wish to wait until the end of December before writing the check. If it looks like you are going to have $100 of income in the year, it will behoove you to wait until the beginning of January before writing out the check. Otherwise you would lose what might count as one of the two profit years required. You also want to guard against being over aggressive with respect to taking deductions. You might bootstrap yourself right out of the presumption.

As always, I have greatly simplified the issues involved. If you are making a little money on the side using your computer and think you might qualify for these benefits, you should consult your accountant or tax attorney.

Kilobaud *Legal/Business Forum*
c/o Ken Widelitz
10960 Wilshire Blvd., Suite 1504
Los Angeles CA 90024

NEW PRODUCTS

(from page 13)

new expansion board, which allows its VIP personal computer to provide video displays in eight colors. RCA's basic VIP unit has heretofore been limited to black and white display on a video monitor or, through an external modulator, onto a standard television set.

The VP-590 Color Board, which retails for $69, allows the user to select one of three background colors for his display; he then specifies one of eight foreground colors for each of 64 screen areas. Any bit turned on in an area will be displayed in the foreground color, while "off" bits in the area will display the background color. Both foreground and background colors can be changed at any time.

Software support for the VP-590 is provided through CHIP-8C, a color graphics language which is upward compatible with the CHIP-8 language used on the present VIP. The VP-590 plugs directly into a socket provided on both existing and future VIP units. The VIP personal computer contains 2K of RAM, a ROM operating system, an audio cassette interface and a video interface. Input is through a 16-key keypad. The unit is completely assembled and has a suggested list price of $249.

RCA COSMAC VIP Marketing, New Holland Avenue, Lancaster PA 17604

Digital Trainer

Now you can train students without previous electronics background or improve your own ability for digital electronic-related assignments with the Model 100 Broder Logic Trainer from L. J. Broder Enterprises, Inc., 3192 Darvany Dr., Dallas TX 75220.

The digital trainer comes with 40 digital logic problems that include all the logic gates, flip-flops, positive- and negative-edge triggered devices and master-slave clocking, as well as preset and clear functions with logic "1" and "0" being active. Switch circuit and Venn diagram problems, as well as BCD and binary counting modes, are included. Physical logic state manipulation and the visual display make for fast and retained learning. Extremely practical problems are related to computers, communications, etc.

The trainer improves and grades the ability of technicians, designers, engineers, technical writers, buyers, etc. In operation the student manipulates component logic states using the 8 logic switches. Solving a problem requires logic switch manipulation to force a logic "1" at the problem card output which will turn on the designated bar indicator.

A manual and a 9 V battery are included. The trainer requires no wire or IC manipulation. Cost is $69.95.

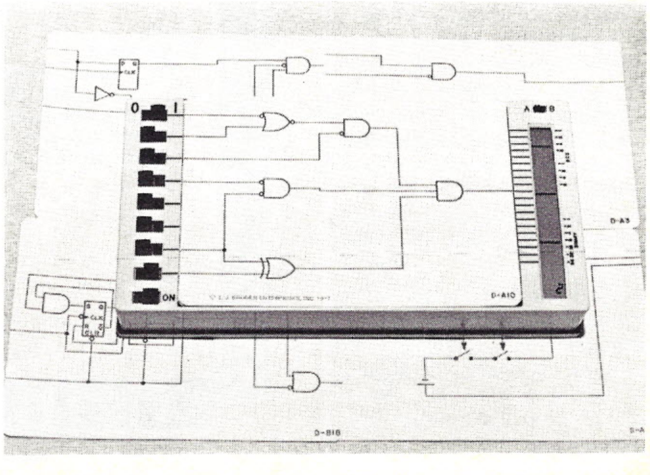
Visable Memory for the KIM

Micro Technology Unlimited announces Visable Memory, a low-cost high resolution graphic display device designed specifically for the KIM-1. The MTU Visable Memory, an 8K memory add-on to the Commodore KIM-1 system, includes the circuitry to simultaneously display the memory contents as 64,000 dots on a TV monitor. You merely connect the board in parallel with the expansion connector on the KIM-1 with two wires also connecting to the application connector.

No modifications to the KIM-1 itself are necessary. The KIM-1 continues to run at full speed with no wait states and no software overhead or CPU time required to refresh the display. Also, there is no snow or other visible interference on the screen when the display memory is being accessed or changed by the KIM CPU.

The basic display format is 200 lines of 320 dots per line. With the optional character display package, up to 18 lines of 40 upper and lowercase characters with true descenders can be displayed. As many as 53 characters per line are possible with some sacrifice in character generation speed. With alternate font tables (5 × 9 is included in the optional software package), characters of varying

(continued on page 117)



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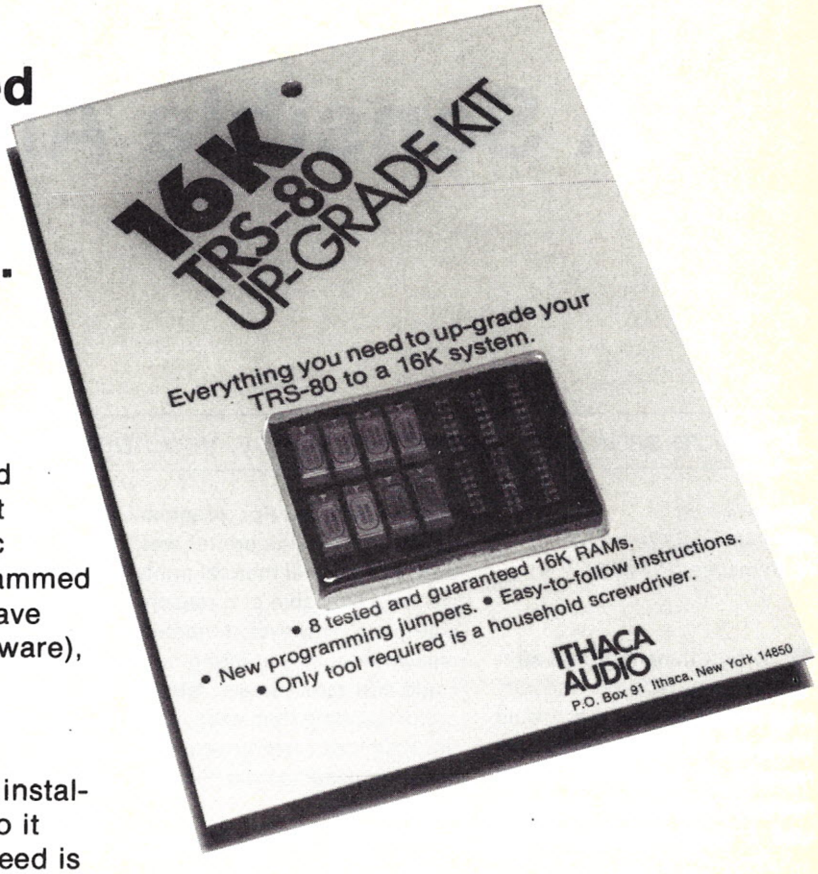

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A Sensible Alternative

If you're seeking low-cost hard copy, you might be interested in the "third alternative."

Kenneth Aird
208 Bellewood Dr.
N. Syracuse NY 13212

The first thing I wanted after I got my SOL up and running was a printer that would allow me to make permanent records of programs, plots, memory dumps or anything else I could display on my monitor screen. For program listings, a fast-line printer was best, and several thermal printers were available at a reasonable price. However, I wanted typewriter-quality printing so I could edit term papers, letters or manuscripts that, except for the absence of errors, would be indistinguishable from manually typed ones.

There are several types of printers that meet this requirement. If you have money to burn, a daisy-wheel printer, such as the Diablo, will give you speeds up to 55 characters per second with bidirectional printing and character spacing to a hundredth of an inch. If your budget is more modest, you can get an IBM Selectric with adapter hardware for $1300 or a used Selectric I/O writer and interface for around $800 to $1000.

I chose a third alternative—a used punch-tape typewriter, based on the Selectric mechanism such as those made by Dura/Itel, with an interface that I designed. I hope this article will be helpful to those who also decide on this third alternative.

The used Dura Mach 10, which I purchased for $500, includes a Selectric typewriter and an eight-hole paper-tape punch and reader, which is the key to the interface as well as being handy for trading programs with other hobbyists whose systems cannot read your cassette tapes.

When I bought the machine, the seller told me it had an 8-bit parallel interface. This turned out to consist of two connectors for an auxiliary paper-tape punch and reader probably used for merging a tape list of names and addresses with a form letter on a tape loop. The connectors are standard miniature female sockets—25 pin for the auxiliary punch and 37 pin for the auxiliary reader; but the electrical interface is hardly standard—except, I hope, within the Dura line.

This article is the result of

Ken Aird in his article-writing workshop. Everything is within easy reach. Headphones aid in finding files on cassette.

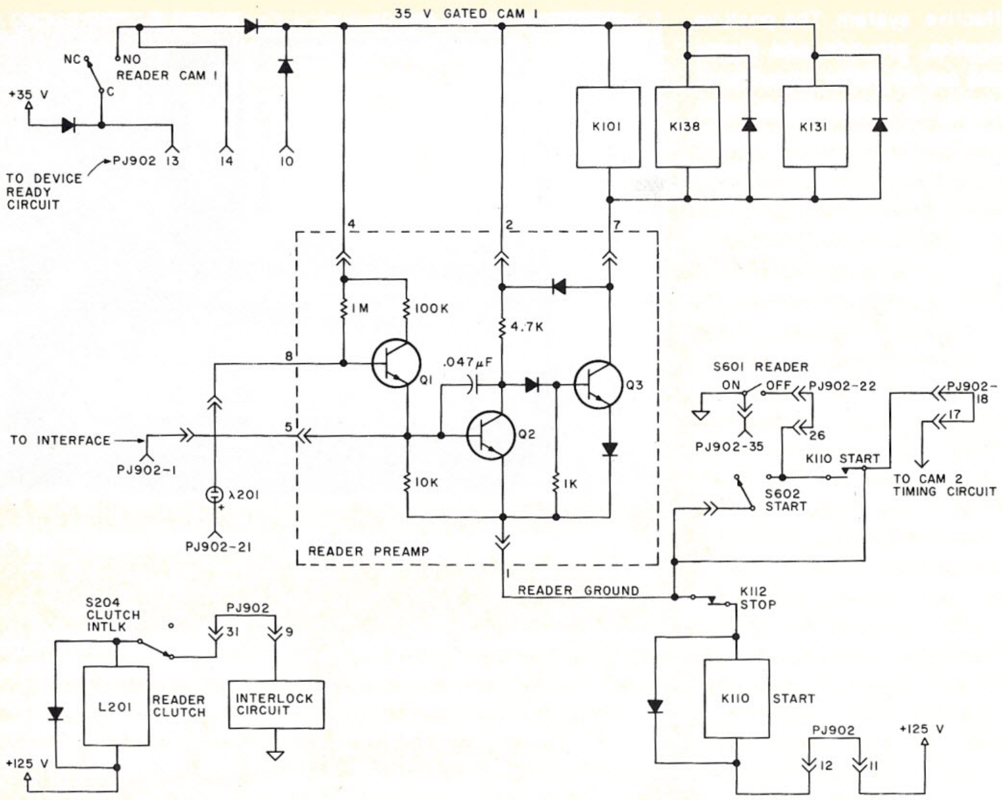

Fig. 1. Section of the wiring diagram for the Dura Mach 10.

hours of experimentation and staring at the circuit diagrams, which I was lucky enough to get with the unit.

Design Considerations

The primary limitations that influenced my interface design were limited funds, limited electronic-design experience and limited patience. At the time, $500 was the most I was willing to pay for hard copy, and I did not relish the thought of paying another $200 or so just to connect it to my computer. Although I understand digital logic fairly well, I have had little experience in practical design, but enough to convince me that even a very simple design can take a lot of work to implement.

This knowledge, combined with my intrinsic lack of patience, influenced me to design the simplest possible interface, even if it lacked some of the features I might like. This decision was also compatible with my third requirement: low cost.

Design

The factors listed above led to the following design decisions. The interface would be driven from a parallel port to eliminate serial-to-parallel conversion hardware and allow software control of timing. The Dura would be used for output only; no attempt would be made to use the Selectric keyboard as an input device. This was no problem since the SOL has a nice keyboard for typing text, programs, etc.

The Dura uses an extended version of the Binary Coded Decimal code—some Duras use Selectric correspondence code—and I decided to do the conversion from ASCII with a program rather than to add hardware.

This might cause a problem for people who program in BASIC and do not have access to the output routines of their BASIC interpreter. However, it is usually possible to patch in your own output routine, an option which the SOL monitor explicitly provides. An advantage of this approach is that any type ball can be used, simply by changing the conversion program.

I decided to use the paper-tape reader's circuitry to take full advantage of the decoding and timing logic built into the Dura. This means that whenever you use the printer, the reader must be running to provide timing signals from the reader's cam switches.

Finally, to safeguard against damage to my computer from the 125 volts used for most of the relay logic in the Dura, I decided to optically isolate all signal lines between the computer side and the printer side of the interface.

The Circuit

A portion of the Dura Mach 10 circuit diagram is shown in Fig. 1. When the paper-tape reader is operating normally, the photocell connected to pin 8 of the preamp reverse biases the input transistor (Q1) whenever there is a hole in the tape allowing light to energize it.

This turns off the second transistor (Q2), and its high collector voltage forward biases the output transistor (Q3), which energizes relays K101, K138 and K131. These relays form part of the decoding logic that operates the proper solenoids to print the character or operate the function that the code represents.

The shaft on the reader, driven by a gear on the main Selectric drive shaft, has two cams that operate timing switches, Cam 1 and Cam 2. The Cam 1 switch, shown in the upper left corner of Fig. 1, gates the 35 volt supply for the reader amplifiers and logic relays, ensuring that the solenoids are not actuated until the paper tape is in position for the next character.

The Cam 2 switch supplies power to the paper-tape punch solenoids. The reader performs a complete cycle in a little less than 65 milliseconds (ms), allowing the printer to operate at its maximum speed of 15.4 characters per second.

The exact timing of the cam switches is shown in Fig. 2. At the end of a cycle, the reader advances the tape sprocket one position and stops. To print the next character it must be started again by a solenoid-operated clutch. This clutch is powered by an interlock circuit that ensures the previous operation, which may take a variable amount of time such as in a tab or carriage return, is com-

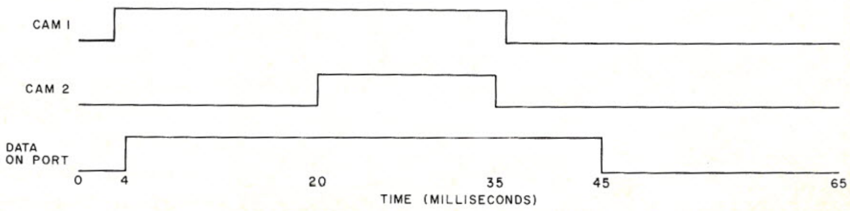

Fig. 2. Timing diagram for the reader cam switches and the interface driver.

My text editor displays the manuscript on the SOL monitor as it is typed.

pleted first.

My interface takes advantage of the reader circuitry by using the photocell amplifiers and relay decoding logic to input codes, and the reader cam switches to gate the printer solenoids and provide a Device Ready signal. Pins 1 to 8 of the 37-pin auxiliary reader socket provide access to the second stage of the photocell amplifiers as shown in Fig. 1. If you disable the reader lamps or cover the cells with a piece of blank paper tape to keep the photocells dark, then Q2 is normally forward biased, and the interface only needs to ground it to simulate a hole in the tape.

The 35 V gated by Cam 1 is ideal as a Device Ready signal since it turns on exactly when the code is first needed, and never until the reader is running and the printer is ready for another character.

The interface circuit, shown in Fig. 3, uses these facts to allow an extremely simple, yet effective, system. The positive supplies, grounds and signal lines are all either separate or isolated by optocouplers, thus providing safety and minimizing interference from the noise caused by the many high-voltage inductors and relay contacts in the Dura.

Each bit of the computer's parallel port is connected in series with the light-emitting diode (LED) of an optocoupler and a current-limiting resistor to a 5 volt regulated supply. A higher-value resistor may work if you have more than one device on your port and the interface is loading it too heavily.

The photo-transistor side of each optocoupler shorts the second stage of an amplifier to ground whenever the LED is conducting. This means that a zero on the parallel port, which causes the diode to conduct, simulates a hole in the paper tape.

Also, since the collector of the optocoupler's output transistor is not biased, the paper-tape reader can be used normally if the 5 V supply is turned off or all ones are placed on the parallel port.

The Device Ready signal is derived by passing the 35 V gated by Cam 1 through the input of an optocoupler with a 10k current-limiting resistor. The output transistor's collector is biased toward 5 V and grounded by a ready signal giving the inverted External Device Ready specified in the SOL interface definition.

Construction

I constructed the interface on a standard Vector board with a 44-pin edge connector available from Radio Shack or electronics distributors. I used ordinary wire-wrap sockets and Vector Slit 'N Wrap wiring soldered directly to the edge connector pads and solder-wrapped to the resistor leads.

The 7805 voltage regulator mounted on the board with a makeshift heat sink (not recommended) was originally powered from the 35 V supply of the Dura. Since this pushed the input voltage limits of the regulator, and noise occurred on the common ground line, I am now using a separate 5 V supply I had for use in experiments.

I recommend powering the regulator from either the 8 V filtered supply of your computer or any regulated 5 V supply you have handy. The eight LEDs are not required, but give a quick indication of what is actually on the parallel port, and are very handy for pinning down the cause of malfunctions.

I can't help much with sources for parts, since most of mine were scrap. The optoisolators were test devices from General Electric. They are GE type H11A, which is equivalent to type 4N26. (The optocoupler is an LED and a phototransistor packaged together with a transparent insulating material between them.) The breakdown voltage between the diode and the transistor is over 1000 volts, which is more than even the Dura generates.

I had trouble finding a 37-pin plug, but they are available for around $10 from makers such as Cinch and Amphenol. Also try Ron Jenkins, whom I mention at the end of the article. The cable to hook up to my computer is 50-conductor telephone cable ripped out of an office where a new phone system was being installed! I guess I'm just lucky.

The Driver Program

What is a driver program? One of the first programs written for any computer is a standardized input/output program. Often it is included in the monitor in read-only memory supplied with your computer. With such a program, every other program that needs to access a device simply makes a stan-

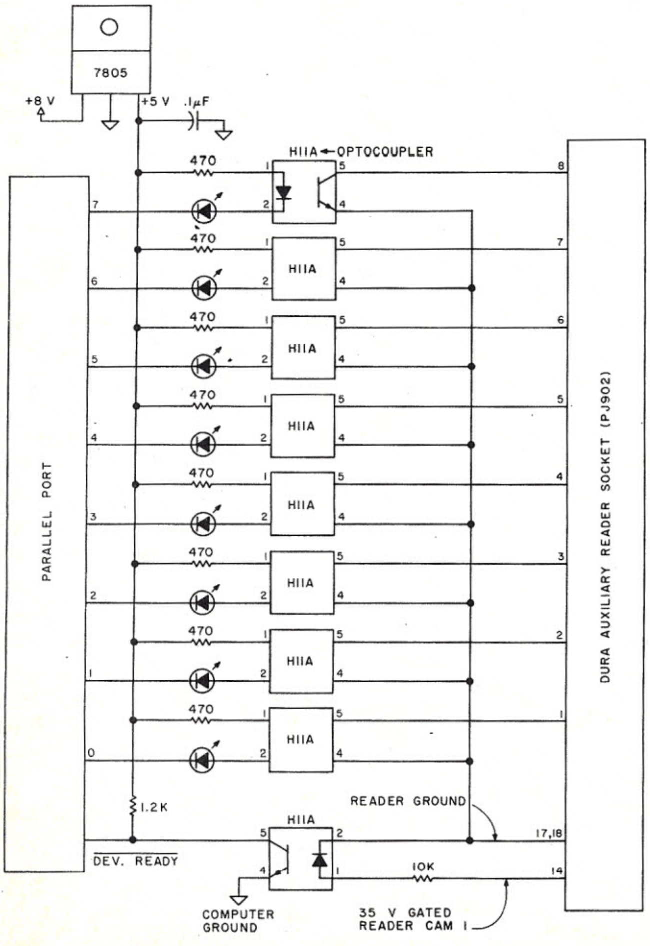

Fig. 3. Schematic of the interface.

dard call to the monitor, which then passes the data to or from the device via a small routine called the driver.

This way if you buy a new printer, your application programs don't have to be changed. All you do is write a new driver routine, which takes care of testing the status flags and sending data to the correct port. In this case, the driver also takes care of code conversion from ASCII (which your programs require) to BCD (which the Dura requires).

To use this driver your program simply moves the ASCII code you want to print into register B and calls the driver at the location labeled DURA. The driver looks this code up in its tables and, if it is a printing character, waits until the Dura is ready to print and then outputs the correct Dura code. Since the Selectric uses uppercase and lowercase, the driver will sometimes output a shift code first to rotate the type ball to the side of the desired letter.

This version of the driver works with the IBM 927 type ball. Certain characters not on the ball, but common in BASIC programs—namely, <, > and ↑—are simulated by LT, GT and **, respectively. Also, some characters will print in uppercase or lowercase. To avoid your wasting time with unnecessary shifts, these characters are included in the table of special codes and output—no need to check what case the Dura is in.

The main conversion table is a list of the Dura codes for all the ASCII codes in order from 32, the first printing code, to 128, the last ASCII code. By trying all possible codes, it should be easy to build a conversion table for any type ball, whether it is BCD or correspondence coded. The special routines will also have to be modified, of course.

I stated earlier that a parallel port is used to allow software control of timing. Fig. 2 shows that the driver puts the Dura code on the port as soon as Cam switch 1 closes, and leaves it there for 40 ms. This ensures that the code is there for as long as the printer logic is enabled, but leaves enough time for the calling program to send another character before the Dura is ready for the next cycle.

In fact, your program has about 20 ms to call the driver with the next character. If it takes longer, the driver may be called in the middle of a cycle and the Dura's relay logic may not have time to register the code. This results in erratic printing.

One solution might be to have the driver wait for a not-ready-to-ready transition, ensuring that it is at the start of a cycle, before putting the code on the port. I have tried this with little success—maybe because the Cam switches bounce each time they close, turning on and off many times.

There are ways to get around this, and you may want to experiment with them. I would be very pleased to learn of any solution you come up with. In the meantime, most of my programs have no trouble coming up with the next character in 20 ms, so I am in no hurry. I do find that it helps to output a couple of shift codes before printing, which gets the program synchronized with the Dura and makes sure it is shifted correctly.

The program listings are for an 8080 processor and are assembled at a location that happens to be free in the SOL system memory. It should be easy to relocate to any memory location. I must warn you that the program has not actually been assembled by me—I have no assembler yet—so I cannot guarantee that it will assemble correctly. However, the object code has been checked against a dump of the working program.

The ASCII entry outputs data in ASCII without conversion, except inversion for proper polarity. This is used with the non-print feature of the Dura to punch paper tapes to be read on other machines.

Certain ASCII codes are also Dura control codes, such as print-restore, which should cause the typer to start printing again, but, for some reason, they do not seem to interfere with my punching ASCII tapes. I would be interested in other people's experiences with this feature.

Other than relocation and changing the tables for different type balls, the only changes you should have to make in the driver are in the PRINT routine. There, the parallel port number, status port number and Device Ready bit mask will have to be changed to match your I/O hardware.

For those with a different processor, I hope that the flowchart of Fig. 4, along with the tables in the listing, will make it fairly easy to write your own version of the driver. Only two registers (A and B) plus the stack are used explicitly, so the program should be easy to write for any machine.

There are a few tricks in the program that may need further explanation. It is clear from the flowchart that all paths eventually lead to the point at the top right corner, which is labeled PRINT in the listing. Rather than use three bytes for an explicit jump instruction at the end of each special routine, I pushed the address of PRINT onto the stack at the very beginning of the program so that a subsequent return instruction, which uses only one byte, has the same effect as a jump to PRINT.

In the table of special codes, SPTAB, each code is followed by the address of the routine to


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There are several types of printer available which
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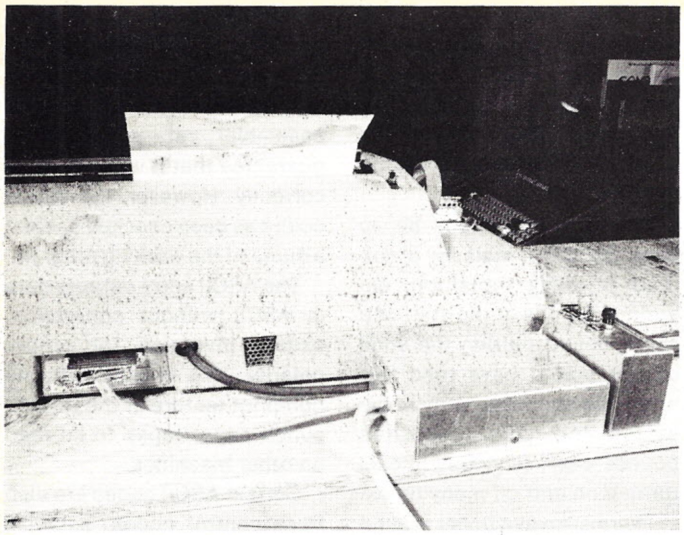
Typing the manuscript. Note the justified right margin.



The interface at work.

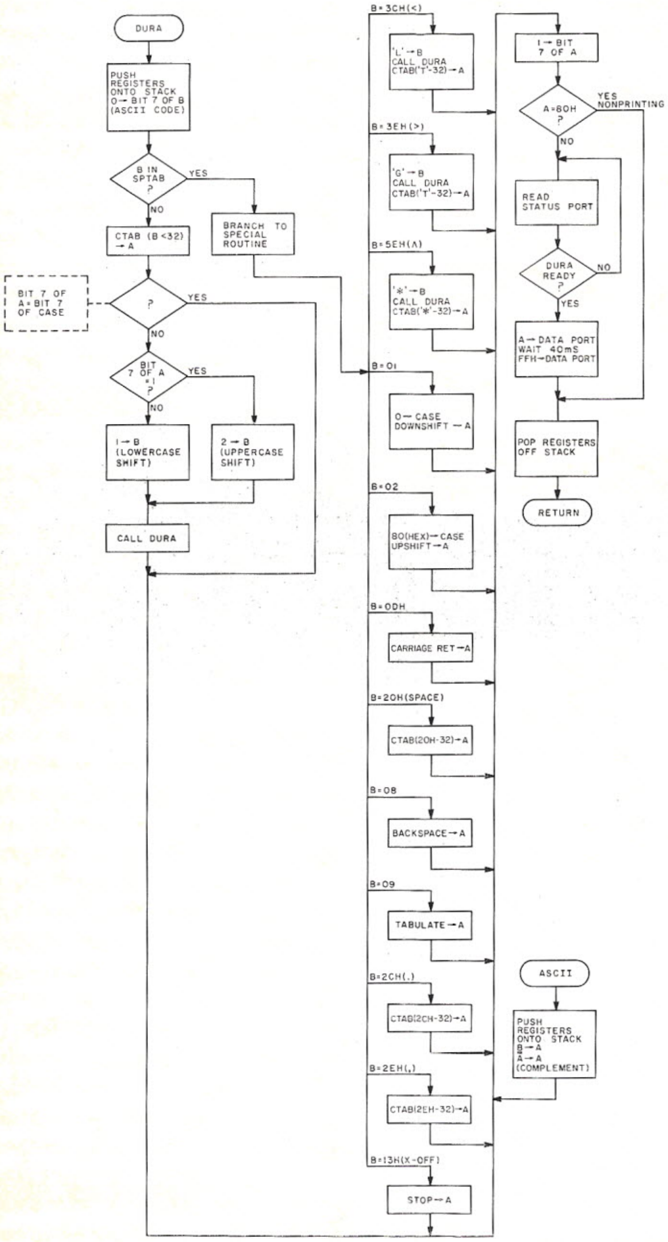


Fig. 4. Flowchart of the interface driver program.

be executed when that code is encountered. Since the special routines are short, and all fit in well under 256 bytes, I decided to use a single-byte relative address instead of the two-byte absolute address.

When the driver finds a match in the table, it gets the relative address from the table and adds it to the address of the first special routine for the actual address of the desired routine. The PCHL instruction loads the program counter with the address just calculated, effectively doing a jump to the special routine.

When the driver has to output a shift code to put the Dura in the correct case, I cannot simply load the Dura shift code and call PRINT because PRINT assumes it is always the last routine called and restores the registers from the stack before returning.

Instead, I use a trick called a recursive call, which has many other more sophisticated uses that I won't go into here. Essentially, the driver calls itself to output the shift code. If the program stored any variables in fixed locations, this could cause problems—because when it returned to itself it might have changed their values.

This is done intentionally with the CASE variable, which should be changed when the status of the Dura changes. A variable, such as CASE, stored in a fixed location that can be looked at by any subroutine is called global. The value of register A, which is the converted code to be output after the shift, is a local variable.

When I call the driver recursively I don't want it to change the value of A, even though I know the program must change A since it is the same program! This problem is handled in a familiar way.

At the beginning of the driver, all the registers, which in this case include all the local variables, are pushed on the stack. At the end of the routine they are popped off again and have the same value as when the routine was called. This is true even when the caller is the subroutine itself.

In the special routines that output two character codes, I mix the recursive call for the first character with the RET trick which jumps to PRINT for the second character. Since the call to DURA needs the ASCII code while PRINT needs the converted Dura code, I use two different codes for the asterisk, which can be quite confusing.

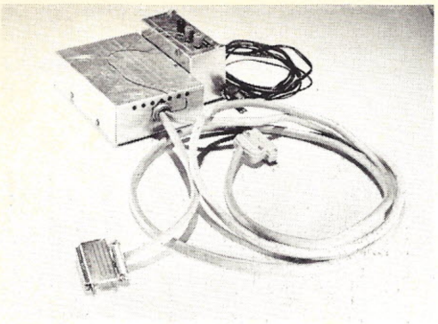
Tricky code such as this can be hard to understand and modify. It only saves a few bytes—about 50 in this program—and requires a line of explanation for each byte saved. However, I believe it is justified for a program such as this, which will probably be used with every other program and will not require frequent modification.

In fact, the driver may be used so much you will want to put it in read-only memory. This is easy to do, since only one byte of the program, CASE, is changed by the program and thus must be in RAM. Still you may want the conversion table and special routines in RAM so you can change type balls easily.

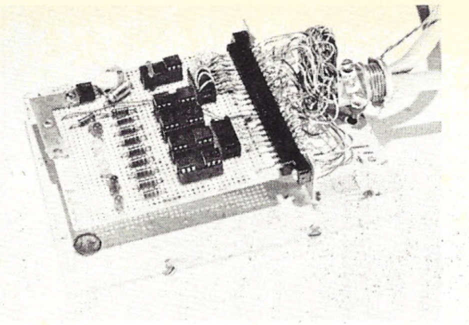
Pitfalls

I hope that all Dura or Itel units of the same vintage as mine use the same interface for their auxiliary reader. However, even if this is the case, it is essential to have a set of wiring diagrams for your unit because many different options and features have been added at various times. At some time, you will need to debug a problem with your unit, which will be nearly impossible without these diagrams.

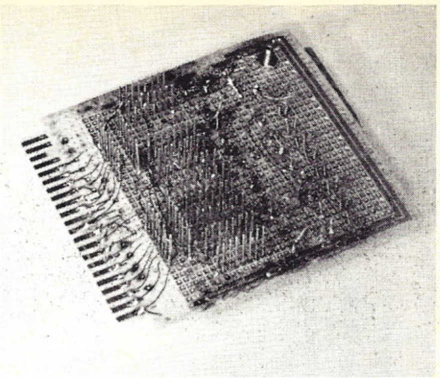
I learned the hard way that operation of the paper-tape reader requires the installation of several jumpers on the auxiliary reader socket. Three of them, pins 11-12, 17-18 and 9-31, are shown in Fig. 1. A jumper between pins 16-34 may be needed to turn on the reader lamps if you want to actually read paper tapes. The lamps are not needed for the interface and must be blocked with an opaque piece of paper if they are on.



The complete interface. Large metal connector plugs into the Dura. Smaller one goes to the SOL parallel port. Box with 3 binder posts is 5 V power supply.



Top view of the interface circuit board. Empty sockets are wired to the edge connector pads for easy wire-wrap modifications.



Bottom view of the interface circuit board showing Slit 'N Wrap wiring methods.

Some of these jumpers may be hard-wired inside the Dura on the actual circuit boards. The model and serial numbers of my unit are given in the driver listing. How much they will tell you depends on how much you know about Duras.

If the Dura is shifted into uppercase by the interface and then turned off, it will stay in uppercase, and no amount of fiddling with the shift key will help. I've read that you can play with the mechanism inside and get it to shift down, but I find that it is easier to just output a lowercase shift from a program.

This assumes, of course, that you have a working interface. If not, you can make a paper tape of all lowercase shifts by turning the punch on and off while shifting up and down.

When you are through wiring your interface and are all ready to power up, stop! Get some sleep. Then double- and triple-check your wiring and measure the voltages to ground on all of the pins of the computer's interface connector before plugging in to the computer. There are many pins on the auxiliary reader socket with high voltages—some 125 V—that will fry a lot of expensive chips if you short them to ground by mistake.

Also note in Fig. 1 several places to tap into ground, including pins 35, 22 and 17. If you use any of them except 17, you will find 125 V on your signal lines when the reader is not running. This is because the ground on the preamps is connected via the coil on the Start relay to 125 V, and it sneaks through the 10k resistor to the interface input.

This is OK if your ground is also at 125 V, but if you use an actual 0 V ground, you will have problems. The worst you can do is blow some optoisolators.

Conclusion

There are alternatives for the hobbyist who wants high-quality hard copy. I believe that my choice is still the cheapest, especially if you sacrifice features in favor of low cost. I want to acknowledge a lot of help I have received from Ron Jenkins of Sirius Micro Systems, 4490 Sirius Ave., Lompoc CA 93436. He has provided me with wiring diagrams, manuals, parts and valuable advice.

He is marketing a Dura interface that will control the timing of the typer by simulating the reader cams with reed relays and will have several options for interfacing to the computer. I don't know if he plans to offer hardware code conversion at this time. I suggest you write to him if you don't want to go to the trouble of building your own interface. Of course, you will have to pay more, but if you have more money than time, go right ahead.

Now that you have a high-quality printer, what about the software to fancy-edit letters and papers? Well, the manuscript for this article, as well as the listings of the driver, were edited on my SOL using a program I wrote.

This allows me to move the cursor to any point in the text with four keys for right, left, up and down; insert or delete text at any point with the existing text moving out of the way before my eyes; print the text on my Dura with automatic indenting and right justification; and accomplish many other features which I won't describe here because they are the subject of my next article.

If you don't want to wait for my article, a similar program is available for $100 from Michael Shrayer, 3901 Los Feliz Boulevard, Los Angeles CA 90027. With the combination of a Selectric printer and a good video editing program, you can make your micro into a word-processing machine superior to many commercial ones costing over $10,000.■

Program Listing.

```
* Driver Routine for Dura Mach 10
*
* by Kenneth Aird
*
* This version is written for use with  the  Processor
* Technology SOL-20 with SOLOS  monitor  and  the  BCD
* encoded version of  the  Dura  model  133038  serial
* #9957. The eight bits of  the  SOL  parallel  output
* port (FD hex) drive the eight bits of the Dura paper
* tape reader circuits. A zero on  the  parallel  port
* simulates a hole in  the  paper  tape  while  a  one
* represents no hole. The ASCII code in register B  is
* first converted to the corresponding  BCD  code  and
* then output to the port when the Dura  signals  that
* it is ready for another character via  the  External
* Device Ready flag which is bit 2 (0=LSB,  7=MSB)  of
* the status port (FA hex) on the  SOL.  This  bit  is
* zero when the Dura is ready  for  another  character
* and one when it is busy typing or not turned on. Bit
* 7 of the Dura code in the conversion table is a  one
* if the character is upper case and  zero  if  it  is
* lower case. The driver keeps track  of  whether  the
* Dura is in upper or lower case, and outputs a  shift
* code when required.  An  ASCII  01  code  (start  of
* heading) is output as a lower case shift  and  a  02
* code (start of text) as an upper case shift.  It  is
* advisable whenever  possible  to  output  two  shift
* codes every time you start printing  with  the  Dura
* using this interface. This does two  things.  First,
* it makes sure the Dura  is  shifted  into  the  case
* which the driver thinks it  is  in  and  second,  it
* synchronizes the program with the typer and  assures
* that the program will be ready with a new  character
* as soon as the Dura finishes printing the last  one.
* This assumes that the program  can  supply  data  as
* fast as the Dura  can  print  it,  as  it  must  for
* reliable results with this timing method. The  ASCII
* code 13 (x-off)  outputs  a  Dura  stop  code  which
* causes the paper  tape  reader  (and  therefore  the
* printer) to stop. A special table  is  included  for
* those characters which will print in upper or  lower
* case, such as the period, and for some  ASCII  codes
* which are not on the IBM number 927  type  ball  but
* which can be  simulated  with  multiple  characters,
* such  as  the  greater-than  arrow.  This  table  is
* consulted before looking in the main table,  and  if
* the  code  is  found  there  the  special  routine
* associated  with  it  is  executed  instead  of  the
* standard conversion and output.  Non-printing  codes
* result in no action being taken by the driver.  This
* assembly starts at location  CA6F,  just  after  the
* part of the SOL system memory used by SOLOS.
*
```

```
CA6F 00         CASE    DB    0         Current shift flag. The only byte
                *                       that must be in RAM.
CA70 F5         DURA    PUSH  PSW       Enter here. Save registers.
CA71 C5                 PUSH  B
CA72 D5                 PUSH  D
CA73 E5                 PUSH  H
CA74 21 AF CA           LXI   H,PRINT   Driver always ends with PRINT routine.
CA77 E5                 PUSH  H         Now a RET will jump to PRINT.
CA78 16 00              MVI   D,0       DE used to add E to HL using DAD  D.
                *
                * Search the table of special codes for B and go to special
                * routine if found.
                *
CA7A 3E 7F              MVI   A,7FH     Strip bit 7 from ASCII.
CA7C A0                 ANA   B
CA7D 47                 MOV   B,A       Save back in B.
CA7E 21 E5 CA           LXI   H,SPTAB-1 Table of special codes and routines.
CA81 23         CMPSP   INX   H         Point to next code.
CA82 7E                 MOV   A,M       Next code in A.
CA83 FE FF              CPI   0FFH      Table end marked by FF.
CA85 CA 93 CA           JZ    NOTSP     Not a special character?
CA88 B8                 CMP   B         Character in table match B?
CA89 23                 INX   H         Point to special routine address.
CA8A C2 81 CA           JNZ   CMPSP     No match. Try the next one.
CA8D 5E                 MOV   E,M       Get relative address of special routine.
CA8E 21 00 CB           LXI   H,SPRTN   Get base address of special routines.
CA91 19                 DAD   D         Calculate absolute address of routine.
CA92 E9                 PCHL            Branch to the special routine.
                *
                * Use the ASCII code in B as an index into the Dura code table.
                * If a shift is required, output the proper shift code, then
                * go to PRINT with the Dura code in A.
                *
CA93 CD D8 CA   NOTSP   CALL  CONVT     Returns address of the Dura code in HL.
CA96 3A 6F CA           LDA   CASE      Bit 7 is current shift position.
                *                       1=Upper case. 0=Lower case.
CA99 AE                 XRA   M         XOR leaves 0 if same, 1 if different.
CA9A E6 80              ANI   80H       Only bit 7 is important.
CA9C CA AB CA           JZ    OUT       Is shift position correct?
CA9F 7E                 MOV   A,M       Get Dura code to be printed.
CAA0 07                 RLC             Get case bit in carry.
CAA1 06 02              MVI   B,USCOD   Upper case shift code.
CAA3 DA A8 CA           JC    SHIFT     If upper case character, shift up.
CAA6 06 01              MVI   B,DSCOD   Lower case shift code.
CAA8 CD 70 CA   SHIFT   CALL  DURA      Recursive call will do special
                *                       routine for shift code.
CAAB 7E         OUT     MOV   A,M       Get Dura code back.
CAAC F6 80              ORI   80H       All Dura codes have a one in bit 7.
                                        (except carriage return).
CAAE C9                 RET             Go to PRINT (address saved on stack).
                *
                * Wait till the Dura is ready, then output the Dura code in A
                * just long enough for the relay logic to latch.
                *
CAAF 47         PRINT   MOV   B,A       Save code in B.
CAB0 FE 80              CPI   80H       Check for non-printing code.
CAB2 CA C6 CA           JZ    GOBACK    Do nothing.
CAB5 DB FA      READY   IN    0FAH      Read parallel status port.
CAB7 E6 04              ANI   4         Bit 3 is External Device Ready.
CAB9 C2 B5 CA           JNZ   READY     Loop until printer is ready.
CABC 78                 MOV   A,B       Put code on parallel port.
CABD D3 FD              OUT   0FDH
CABF CD A0 CB           CALL  DEBNC     Wait 40 milliseconds.
CAC2 3E FF              MVI   A,0FFH    Clear parallel port.
CAC4 D3 FD              OUT   0FDH
CAC6 E1         GOBACK  POP   H         Restore registers.
CAC7 D1                 POP   D
CAC8 C1                 POP   B
CAC9 F1                 POP   PSW
CACA C9                 RET             Done with this character.
                *                       Return to caller.
                *
                * Enter here to output unconverted ASCII for punch tape.
```

```
                * The value 0FFH in the first byte marks the end of the table.
                *
CAE6 01         SPTAB   DB    DSCOD       Lower case shift.
CAE7 1C                 DB    DS-SPRTN
CAE8 02                 DB    USCOD       Upper case shift.
CAE9 23                 DB    US-SPRTN
CAEA 0D                 DB    0DH         Carriage Return.
CAEB 2B                 DB    CR-SPRTN
CAEC 20                 DB    20H         Space.
CAED 2E                 DB    SP-SPRTN
CAEE 08                 DB    08          Backspace.
CAEF 31                 DB    BS-SPRTN
CAF0 09                 DB    09          Tabulate.
CAF1 34                 DB    TAB-SPRTN
CAF2 2C                 DB    2CH         ,
CAF3 37                 DB    COMA-SPRTN
CAF4 2E                 DB    2EH         .
CAF5 3A                 DB    PER-SPRTN
CAF6 3C                 DB    3CH         Less Than.
CAF7 00                 DB    LT-SPRTN
CAF8 3E                 DB    3EH         Greater Than.
CAF9 0A                 DB    GT-SPRTN
CAFA 5E                 DB    5EH         Up arrow (exponential).
CAFB 14                 DB    POWER-SPRTN
CAFC 13                 DB    13H         X-OFF.  (stop code).
CAFD 3D                 DB    STOP-SPRTN
CAFE FF                 DB    0FFH        End of table.
CAFF 00                 DB    0           Spare room.
                DSCOD   EQU   01          ASCII 01 interpreted as down-shift.
                USCOD   EQU   02          ASCII 03 interpreted as up-shift.
                *
                * Table of Dura codes. The ASCII code minus 32 is
                * the index of the corresponding Dura code in the table.
                * Bit 7 of the Dura code is a one if it is an upper case
                * character and a zero if it is lower case.
                * By replacing this table and making appropriate changes
                * in the special routines, any type ball can be
                * used. This table is for the IBM #927 BCD encoded ball.
                *
CB40 00         CTAB    DB    000H        Space
CB41 A4                 DB    0A4H        !
CB42 F8                 DB    0F8H        "
CB43 60                 DB    060H        #
CB44 24                 DB    024H        $
CB45 EA                 DB    0EAH        %
CB46 0F                 DB    00FH        &
CB47 E9                 DB    0E9H        '
CB48 E6                 DB    0E6H        (
CB49 DF                 DB    0DFH        )
CB4A F7                 DB    0F7H        *
CB4B 8F                 DB    08FH        +
CB4C 44                 DB    044H        ,
CB4D 3F                 DB    03FH        -
CB4E 14                 DB    014H        .
CB4F 4E                 DB    04EH        /
CB50 5F                 DB    05FH        0
CB51 7E                 DB    07EH        1
CB52 7D                 DB    07DH        2
CB53 6C                 DB    06CH        3
CB54 7B                 DB    07BH        4
CB55 6A                 DB    06AH        5
CB56 69                 DB    069H        6
CB57 78                 DB    078H        7
CB58 77                 DB    077H        8
CB59 66                 DB    066H        9
CB5A FB                 DB    0FBH        :
CB5B EC                 DB    0ECH        ;
CB5C 00                 DB    00          Less Than
CB5D FE                 DB    0FEH        =
CB5E 00                 DB    00          Greater Than
CB5F CE                 DB    0CEH        ?
CB60 42                 DB    042H        @
CB61 9E                 DB    09EH        A
```

```
                    * May not work on some Dura machines due to conflict with Dura
                    * control codes such as print-restore.
                    *
CACB F5             ASCII    PUSH  PSW         Save registers.
CACC C5                      PUSH  B
CACD D5                      PUSH  D
CACE E5                      PUSH  H
CACF 78                      MOV   A,B         Get ASCII code in A.
CAD0 2F                      CMA               Make a one punch a hole.
CAD1 C3 AF CA                JMP   PRINT       Output the code to the Dura.
CAD4                         DS    4           Spare room for fixes.
                    *
                    * Return in HL the address of the Dura code for the ASCII
                    * code in B. If the ASCII code is non-printing, return the
                    * address of DEL which has a value of zero.
                    *
CAD8 3E 20          CONVT    MVI   A,20H       Less than 32 is non-printing.
CADA B8                      CMP   B
CADB FA E0 CA                JM    INDEX       Non-printing code?
CADE 06 7F                   MVI   B,7FH       Yes, make it a DEL.
CAE0 58             INDEX    MOV   E,B         Put ASCII in DE.
CAE1 21 20 CB                LXI   H,CTAB-20H  Code table starts at 32.
CAE4 19                      DAD   D           Add code to table base address.
CAE5 C9                      RET               Address of Dura code is in HL.

                    *
                    * Special routines for Comma, Period, Space, Backspace,
                    * Carriage Return and Tabulate which print in upper
                    * or lower case, for Shift and Stop codes, and for
                    * Less Than, Greater Than and Exponential arrows
                    * which print as LT, GT and ** respectively.
                    *
                    SPRTN    EQU   $           Base address of special routines.
CB00 06 4C          LT       MVI   B,'L'       Print LT.
CB02 CD 70 CA                CALL  DURA        Recursive call prints L.
CB05 3E DC                   MVI   A,0DCH      Dura code for T.
CB07 C9                      RET               Go to PRINT.
CB08                         DS    2           Spare bytes.
CB0A 06 47          GT       MVI   B,'G'       Print GT.
CB0C CD 70 CA                CALL  DURA        Recursive call prints G.
CB0F 3E DC                   MVI  A,0DCH       Dura code for T.
CB11 C9                      RET               Go to PRINT.
CB12                         DS    2           Spare bytes.
CB14 06 2A          POWER    MVI   B,'*'       Print ** for up arrow.
CB16 CD 70 CA                CALL  DURA        Recursive call prints *.
CB19 3E F7                   MVI   A,0F7H      Dura code for *.
CB1B C9                      RET               Go to PRINT.
CB1C AF             DS       XRA   A           Lower case shift.
CB1D 32 6F CA                STA   CASE        Set case flag.
CB20 3E 85                   MVI   A,85H       Dura down shift code.
CB22 C9                      RET               Go output it.
CB23 3E 80          US       MVI   A,80H       Upper case shift.
CB25 32 6F CA                STA   CASE        Set case flag.
CB28 3E 83                   MVI   A,83H       Dura upshift code.
CB2A C9                      RET               Go output it.
CB2B 3E 7F          CR       MVI   A,7FH       Carriage Return code.
CB2D C9                      RET
CB2E 3E EF          SP       MVI   A,0EFH      Space code.
CB30 C9                      RET
CB31 3E D5          BS       MVI   A,0D5H      Backspace code.
CB33 C9                      RET
CB34 3E C1          TAB      MVI   A,0C1H      Tabulate code.
CB36 C9                      RET
CB37 3E C4          COMA     MVI   A,0C4H      , code.
CB39 C9                      RET
CB3A 3E 94          PER      MVI   A,94H       . code.
CB3C C9                      RET
CB3D 3E 74          STOP     MVI   A,74H       Dura stop code.
CB3F C9                      RET
                    * Table of special routines. Each entry is two bytes.
                    * First byte is ASCII code. Second byte is the address of
                    * the routine for that code relative to SPRTN.
                    * Adding the second byte to SPRTN gives the absolute address.
```

```
CB62 9D                 DB    09DH      B
CB63 8C                 DB    08CH      C
CB64 9B                 DB    09BH      D
CB65 8A                 DB    08AH      E
CB66 89                 DB    089H      F
CB67 98                 DB    098H      G
CB68 97                 DB    097H      H
CB69 86                 DB    086H      I
CB6A AE                 DB    0AEH      J
CB6B AD                 DB    0ADH      K
CB6C BC                 DB    0BCH      L
CB6D AB                 DB    0ABH      M
CB6E BA                 DB    0BAH      N
CB6F B9                 DB    0B9H      O
CB70 A8                 DB    0A8H      P
CB71 A7                 DB    0A7H      Q
CB72 B6                 DB    0B6H      R
CB73 CD                 DB    0CDH      S
CB74 DC                 DB    0DCH      T
CB75 CB                 DB    0CBH      U
CB76 DA                 DB    0DAH      V
CB77 D9                 DB    0D9H      W
CB78 C8                 DB    0C8H      X
CB79 C7                 DB    0C7H      Y
CB7A D6                 DB    0D6H      Z
CB7B E6                 DB    0E6H      Left bracket prints as (
CB7C 6F                 DB    06FH      Backslash
CB7D DF                 DB    0DFH      Right bracket prints as )
CB7E 00                 DB    00        Up arrow
CB7F BF                 DB    0BFH      Underscore
CB80 E9                 DB    0E9H      '
CB81 1E                 DB    01EH      a
CB82 1D                 DB    01DH      b
CB83 0C                 DB    00CH      c
CB84 1B                 DB    01BH      d
CB85 0A                 DB    00AH      e
CB86 09                 DB    009H      f
CB87 18                 DB    018H      g
CB88 17                 DB    017H      h
CB89 06                 DB    006H      i
CB8A 2E                 DB    02EH      j
CB8B 2D                 DB    02DH      k
CB8C 3C                 DB    03CH      l
CB8D 2B                 DB    02BH      m
CB8E 3A                 DB    03AH      n
CB8F 39                 DB    039H      o
CB90 28                 DB    028H      p
CB91 27                 DB    027H      q
CB92 36                 DB    036H      r
CB93 4D                 DB    04DH      s
CB94 5C                 DB    05CH      t
CB95 4B                 DB    04BH      u
CB96 5A                 DB    05AH      v
CB97 59                 DB    059H      w
CB98 48                 DB    048H      x
CB99 47                 DB    047H      y
CB9A 56                 DB    056H      z
CB9B E6                 DB    0E6H      Left brace prints as (
CB9C A4                 DB    0A4H      Vertical bar prints as !
CB9D DF                 DB    0DF0      Right brace prints as )
CB9E 00                 DB    00        Not sign  non-printing
CB9F 00                 DB    00        DEL  non-printing
                 *
                 * Programmed loop for a delay of about 40 milliseconds.
                 * Assumes an 8080 with a 2 MHz clock and no interrupts.
                 *
CBA0 0E 15       DEBNC      MVI   C,21       1.9 milliseconds/loop
CBA2 3E FF       TIMER      MVI   A,255      Inner loop count.
CBA4 3D          COUNT      DCR   A          7.5 microseconds/loop.
CBA5 C2 A4 CB               JNZ   COUNT      End of inner loop.
CBA8 0D                     DCR   C
CBA9 C2 A2 CB               JNZ   TIMER      End of outer loop.
CBAC C9                     RET
```

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A "Gift" That Keeps on Giving

Thoughts of Christmas past can lead to an ongoing present.

Time: Christmas day 1976.
Place: Brother-in-law's house.
Present: Brother-in-law and two college-professor friends.

"Did you see the price of a Pong game is down to 30 bucks?"

"Yeah, I wouldn't mind having one."

"But I think I'd get tired of playing it pretty soon. I'd really like to have a computer so I could play Star Trek."

That's me swerving the conversation to a favorite subject. Before I quit my job as a patent attorney to take over my father's farm, I had designed a file-management system for my company's patent records. To familiarize me with the capabilities of computers and to allow me to converse intelligently with a walking computer peripheral called a programmer, the company sent me to a FORTRAN IV programming course. The bug bit me hard, and I wrote and ran programs whenever I could. But, when you quit the company, you quit its computer.

So, I sat on the tractor and pined, dreaming a lot and talking about the day computers would be affordable to a wheat farmer in a down market. Meanwhile, back to Christmas day:

"One of my computer-freak buddies at the college told me there's a place in Denver where you can buy a small computer for a few hundred dollars that can play games and help run your home."

If I had been a cat, my ears would have perked up so fast there would have been a sonic boom — was my dream a reality in the present?

My brother-in-law didn't know the name of the store, but he would find out for me. Three weeks later, I was in Denver. A few phone calls to firms listed in the Yellow Pages got me the name of the Byte Shop. I beat a path straight to their door.

The moment I looked around the display room I knew I was in over my head. I didn't have the foggiest idea what components were needed to make a working system or what brand of computer I would like, and I told the salesman so. Without batting an eye, he walked me to the publications rack and recommended some books and magazines to get me started. Twenty dollars lighter, I headed home to many hours of reading.

TTL? CMOS? RAM? ROM? PROM? EPROM? Thank God the man talked me into buying a dictionary. I sent in readers' service cards, pored over the brochures and looked in the dictionary. I thought I'd never understand it all. RS-232? 20 mA loop? How do I interface this with that?

Slowly, however, it began to make sense. What made the most sense was that the system I was beginning to envision was incompatible with my budget. Despair. Think! The only way is to get someone else to help pay for it. In the middle of the boondocks? Who?

Time: March 1977.
Place: My car.
Present: Grain-elevator manager.

"That computer service gives me more headaches than it's worth. They make so many mistakes keypunching. We'll have to switch to an on-line service so we can do our own keypunching."

The light bulb goes on. TIMESHARING!! Put a terminal in the elevator and hook it to my computer by telephone.

Oh boy! Now, what do I need besides a modem (a word I had seen in an ad) and a terminal? I read some more and wrote letters to manufacturers describing what I wanted to do. More brochures arrived, but very little specific guidance. I talked to my cousin, who wrote the programs for the computer service the elevator is now using. Their 8-bit computer has 16K of memory and a megabyte disk (probably won't need that for one customer). He had showed me a console with a floppy disk, which some of the brochures had described. One floppy disk should hold all the necessary information. But the way their business is expanding I will probably need a dual-disk system.

So, based on my meager knowledge, I decided that my system should have a minimum of 16K RAM, a dual floppy disk system, a printer, TV terminals for my home and the elevator, the modems to connect the elevator to my computer, and perhaps the most difficult part — a private telephone line.

Now let's look at the price lists and make a comparative table. One manufacturer stood out above all others in terms of value per dollar. So I figured the total price tag; added in a fudge factor, interest and maintenance; assumed a three year payout; and told the elevator manager I could set him up for $250 per month plus the cost of the forms to print his statements. Now *his* ears perked up. That was $350 per month less than the other on-line service he could buy. He didn't even want to wait until fall so I could have more time to work on the system. I got him calmed down and extended the time frame.

Fright! Paralyzing fright!! I had never programmed in BASIC. Could I handle such a complex job? I sent for books, studied every program in the magazines and started flowcharting. I wished for a computer so I could test some programs.

You may call this a dream, but I know that within six months I will have someone else paying for my hobby. There must be thousands of potential customers who would be more than happy to help pay for your computer. Start looking around. Anyone with an inventory or accounts-receivable problem is a prime candidate. But take a word of warning from a lawyer; get a signed contract *before* you lay out the bucks for the equipment and a remote terminal.

The first month or so, there are bound to be problems. Don't let the customer back out before he has a chance to become familiar with the system. Keep him happy and adjust the rental during these problem times. Remember, you are a salesman backing up your warranty. Think how you would want to be treated. ■

SPINTERM T.M.

FASTER THAN THE DEVIL! at 55 characters per second.

More characters—up to 128 on an interchangeable print thimble.

Longer life with a print thimble that gives over 30,000,000 impressions.

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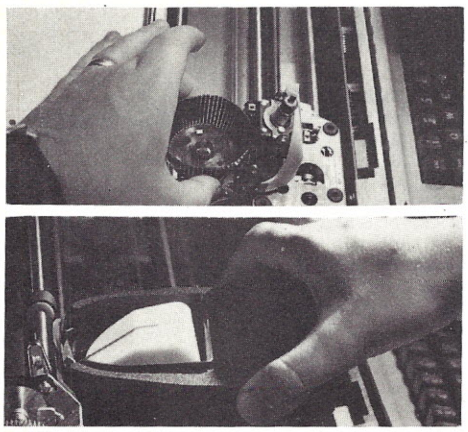

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SPINTERM

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(Name withheld by request)

The Art of Generating Expense Reports

Have fun, fun, fun without also having martini, martini, martini.

No, I am not trying to cheat on expense reports for the company I work; I am playing the game by their own rules: I'm just trying to make my work a little easier. Another way of looking at it is that this program is a practical use for a random number generator, something other than the usual guessing game.

Expense reports aren't bad for a one-day or two-day trip. But imagine a three-week, four-week or even a two-month expense report! Enough to drive you up a proverbial wall. I guess on that big one it took me two days of adding columns and rows to make everything add up correctly (and with luck to the amount of the advance I had left). Sure, the idea of writing down everything you spend for meals in a little book is OK for about a week. Then the entries start to get messy and a day or two late as Motel Syndrome settles in. (What? Eat at a hamburger joint and then have Fun, Fun, Fun at night? Well, maybe once in awhile.)

Let's look at the company rules for expense reports.

1. Receipts are needed for rooms.
2. Receipts are needed for car rental.
3. Receipts are needed for gasoline.
4. Receipts are not needed for meals (our ace in the hole).
5. Meals should average about $15 a day, depending on area.
6. Meals should be reasonably priced.
7. No expenses allowed (on my level) for Fun, Fun, Fun.
8. All the horizontal (daily) rows must add up.
9. All vertical rows must add up.
10. Spending too little will mess up your buddies on their next trip.

The Program

I do not pretend that this program is so successful that it can't be recoded to be more compact and more efficient. Here's how it works.

Number of days will determine the size of the array in the DIMension statement. Horizontal elements, 0 to 5, are for date, breakfast, lunch, dinner, room and special values. The starting date (MM, DD, YY) will fill in the zero element of the array with the date. Included is a correction for leap years if YY is divisible by 4.

Room rates are variable in steps based on the number of days you dictate. (Remember, on the last day you didn't sleep in a motel, you were flying home.)

If you say (Y)es to the standard meal deductions you will accept the following: Breakfast averages $1.50 ± .20 for ±3 increments; Lunch averages $2.50 ± .50 for ±3 increments; Dinner averages $6.50 ± 0.75 for ±3 increments. If you say (N)o, then you will use your own averages, slop values and del values. Whether you choose

```
#OF DAYS; 3
START DATE MM,DD,YY? 8,1,77
REPORT WILL COVER 8/1/1977 TO 8/3/1977
STARTING DOLLARS YOU HAD? 700
DOLLARS YOU ENDED UP WITH? 354.78
ROOM RATE? 25
#OF DAYS AT RATE 25.00? 2
DAYS REMAINING 1
ROOM RATE? 0
#OF DAYS AT RATE  0.00? 1
STANDARD MEAL DEDUCTIONS (Y)ES OR (N)O? Y
TOTALS
B=4.50      L=7.50      D=22.50     R=50.00     S=0.00

START VALUE          =700.00
END VALUE            =354.78
TOTAL NOW            =  84.50
UNACCOUNTED          =260.72

EXEC MODE
P=PRINT REPORT       S=SPECIAL
C=CHANGE MEALS       X=RE-RANDOMIZE MEALS
D=DISPLAY DATE       ?=COMMANDS AGAIN
R=ROOM RATE          I=ITERATIVE MEAL INCREASE
T=TOTALS             E=END
? S
DATE OF SPECIAL MM,DD? 8.2
AMOUNT OF PURCHASE ? 7.50
REASON OF PURCHASE ? TAXI
UNACCOUNTABLES ARE 253.22
EXEC MODE
? D
DATE YOU WISH DISPLAYED  MM,DD? 8,1
B=1.70  L=3.00  D=8.00  R=25.00  S=0.00
CHANGE VALUE (Y)ES OR (N)O? Y
B/L/D/R/S ? B
NEW VALUE IS ? 0
B=0.00  L=3.00  D=8.00  R=25.00  S=0.00
CHANGE VALUE (Y)ES OR (N)O? N
EXEC MODE
? I
UNACCOUNTABLES ARE $254.92
REDUCE UNACCOUNTABLES TO WHAT VALUE? 230
ITERATING BY  2.76
ITERATING BY .31
ITERATING BY .04
ITERATING BY .01

TOTALS
B=9.03  L=16.85  D=31.84  R=50.00  S=7.50
START VALUE         =700.00
END VALUE           =354.78
TOTAL NOW           =115.22
UNACCOUNTED         =230.00
EXEC MODE
? P
```

Executive expense report generator.

```
---------------

EXPENSE REPORT COVERING 8/1/1977 TO 8/3/1977

DATE       BREAK.        LUNCH        DINNER       ROOM       SPECIAL       REASON       TOTAL

8/01       0.00          6.12         11.12        25.00      0.00                       42.24
8/02       4.62          4.12         11.86        25.00      7.50          TAXI         53.10
8/03       4.41          6.61          8.86         0.00      0.00                       19.88
===================================================================================================

3 DAYS     9.03          16.85        31.84        50.00      7.50                       115.22

START VALUE              =700.00
END VALUE                =354.78
TOTAL NOW                =115.22
UNACCOUNTED              =230.00

---------------
```

Expense report covering 8/1/77 to 8/3/77.

the standard deductions or your own, the matrix will be randomly filled in with values for the three meals.

The program has an EXEC MODE. Its special commands are:

PRINT REPORT (P). Will generate a complete matrix with horizontal and vertical totals, including a total report.

SPECIAL (S). Allows you to insert items such as laundry, taxi, etc., by a given date.

CHANGE MEALS(C). Allows a positive or negative vertical increase on the meal of your choice (e.g., all the dinners should be increased about $1.50 more). This change happens on all nonzero meals.

RE-RANDOMIZE MEALS (X). Means that you have decided after all to take the (N)o path for the standard meal deductions.

DISPLAY DATE (D). Allows you to change any of the five variable elements. This is how you zero a meal (e.g., breakfast for the first day was zero since you didn't fly out til 9 am).

COMMANDS AGAIN(?). Reprints the commands in case you get mixed up.

ROOM RATE(R). Allows a complete overhaul of the room-rate structure (better have receipts).

Other commands include *TOTALS (T)* and *END (E)* *ITERATIVE MEAL INCREASE (I)* is perhaps the most interesting command. If, for example, your unaccountables are $280.56 and you would like to reduce this item to $250.00 (because you're too cheap to make up the difference), the command will calculate how much to add to all nonzero meals so that the total unaccountables will be what you have specified. This portion of the program takes time and will go through three or four passes until it gets the unaccountables to your specified values. Relax and watch the lights blink. Remember, the alternative is to run the horizontal and vertical sums with a calculator . . . or *pay*.

Remarks

The program was written in Altair 8K BASIC (for the 680b). Floating-point numbers tend to be a problem, especially when you're trying to get rows and columns to add up to the penny. For this reason, all values are carried as an integer value, 100 times the printed value. The Q, Q$ subroutine at line 2280 is a method of columnizing dollars and cents values in lieu of a PRINT USING statement.

Eat at the hamburger stand; then you can afford to have fun, fun, fun. ■

Program listing.

```
10 PRINT:PRINT
20 PRINTTAB(15);"EXECUTIVE EXPENSE REPORT GENERATOR"
30 PRINT:PRINT
40 DATA31,28,31,30,31,30,31,31,30,31,30,31
50 CLEAR1000
60 INPUT" #OF DAYS";DY
70 DIMA(DY,5),R$(DY),MZ(12)
80 INPUT"START DATE MM, DD, YY";MM, DD, YY
90 D1$=RIGHT$(STR$(MM),LEN(STR$(MM))-1)+" / "
100 D1$=D1$+RIGHT$(STR$(DD),LEN(STR$(DD))-1)+"/19"
110 D1$=D1$+RIGHT$(STR$(YY),LEN(STR$(YY))-1)
120 IFMM >120RDD >310RABS(INT(MM)) <> MMORABS(INT(DD)) <> DDTHEN80
130 FORN=1TO12:READMZ(N):NEXT:IFINT(YY/4)=YY/4THENMZ(2)=29
140 N=1
150 FORN1=DDTOMZ(MM):A(N,0)=MM*100+N1
160 N=N+1:IFN >DYTHEN190
170 NEXTN1:DD=1:MM=MM+1:IFMM=13THENMM=1:YY=YY+1
180 GOTO150
190 D2$=RIGHT$(STR$(MM),LEN(STR$(MM))-1)+"/"
200 D2$=D2$+RIGHT$(STR$(N1),LEN(STR$(N1))-1)+"/19"
210 D2$=D2$+RIGHT$(STR$(YY),LEN(STR$(YY))-1)
220 PRINT"REPORT WILL COVER ";D1$;" TO ";D2$
230 INPUT"STARTING DOLLARS YOU HAD";SD
240 INPUT"DOLLARS YOU ENDED UP WITH";EV
250 SD=INT(100*SD):EV=INT(100*EV)
260 C=0
270 INPUT"ROOM RATE";RR:RR=INT(100*RR):Q=RR:R=6
280 PRINT" #OF DAYS AT RATE ";:GOSUB2280:INPUT T
290 IFC+T >DYTHENPRINT"IMPOSSIBLE   START OVER":GOTO260
300 FORN=1TOT:A((C+N),4)=RR:NEXTN
310 C=C+T:IFC< DYTHENPRINT"DAYS REMAINING ";DY-C:GOTO270
320 IFFL <>0THEN680
330 INPUT"STANDARD MEAL DEDUCTIONS (Y)ES OR (N)O";T$
340 IFT$="N"THEN380
350 IFT$ <>"Y"THEN330
360 AB=1.5:AL=2.5:AD=6.5:BS=.2:LS=.5:DS=.75:D1=-3:D2=3
370 GOTO600
380 INPUT"AVERAGE BREAKFAST $1.50 (Y)ES OR (N)O";T$
390 IFT$="Y"THENAB=1.5:GOTO420
400 IFT$ <>"N"THEN380
410 INPUT"AVERAGE BREAKFAST WAS ";AB
```

```
420 INPUT“AVERAGE LUNCH WAS $2.50   (Y)ES OR (N)O”;T$
430 IFT$=“Y”THENAL=2.5:GOTO460
440 IFT$<>“N”THEN420
450 INPUT“AVERAGE LUNCH WAS ”;AL
460 INPUT“AVERAGE DINNER WAS $6.50   (Y)ES OR (N)O”;T$
470 IF T$=“Y”THENAD=6.5:GOTO500
480 IFT$<>“N”THEN460
490 INPUT“AVERAGE DINNER WAS ”;AD
500 PRINT“SLOP RANGES ARE:”
510 INPUT“BREAKFAST =.20   LUNCH =.50   DINNER =.75   (Y)ES OR (N)O”;T$
520 IFT$=“Y”THENBS=.2:LS=.5:DS=.75:GOTO550
530 IFT$<>“N”THEN510
540 INPUT“SLOP RANGES ARE   BB,LL,DD”;BS,LS,DS
550 IFFL=0THENT$=“Y”:GOTO570
560 INPUT“DEL VALUES OF -3 AND +3 OK? (Y)ES OR (N)O”;T$
570 IFT$=“Y”THEND1=-3:D2=3:GOTO600
580 IFT$<>“N”THEN560
590 INPUT“PLEASE SUPPLY DEL VALUES -D,+D”;D1,D2:IFD1>0THEND1=-D1
600 FORN=1TODY
610 GOSUB1130:A(N,1)=AB+INT(100*R*BS)/100
620 A(N,1)=INT(100*A(N,1))
630 GOSUB1130:A(N,2)=AL+INT(100*R*LS)/100
640 A(N,2)=INT(100*A(N,2))
650 GOSUB1130:A(N,3)=AD+INT(100*R*DS)/100
660 A(N,3)=INT(100*A(N,3))
670 NEXTN
680 GOSUB900:GOSUB1000
690 PRINT
700 PRINT“EXEC MODE”
710 IFFL<>0THEN780
720 FL=1
730 PRINT“P=PRINT REPORT          S=SPECIAL”
740 PRINT“C=CHANGE MEALS          X=RE-RANDOMIZE MEALS”
750 PRINT“D=DISPLAY DATE          ?=COMMANDS AGAIN”
760 PRINT“R=ROOM RATE             I=ITERATIVE MEAL INCREASE”
770 PRINT“T=TOTALS                E=END
780 INPUTT$
790 IFT$=“P”THENNULL3:GOTO1190
800 IFT$=“S”THEN1560
810 IFT$=“C”THEN1720
820 IFT$=“X”THEN380
830 IFT$=“D”THEN1830
840 IFT$=“?”THEN730
850 IFT$=“R”THEN260
860 IFT$=“I”THEN2090
870 IFT$=“T”THENGOSUB900:GOSUB1000:GOTO700
880 IFT$=“E”THENSTOP
890 PRINT“**ERROR**”:FL=0:GOTO700
900 BT=0:LT=0:DT=0:RT=0:ST=0
910 FORN=1TODY
920 BT=BT+A(N,1)
930 LT=LT+A(N,2)
940 DT=DT+A(N,3)
950 RT=RT+A(N,4)
960 ST=ST+A(N,5)
970 NEXTN
980 UA=SD~~b~~ - ~~b~~(BT+LT+DT+RT+ST+EV)
990 RETURN
1000 PRINT“TOTALS”
1010 R=-99
1020 Q=BT:PRINT“B=”;:GOSUB2280
1030 Q=LT:PRINT“L=”;:GOSUB2280
1040 Q=DT:PRINT“D=”;:GOSUB2280
1050 Q=RT:PRINT“R=”;:GOSUB2280
1060 Q=ST:PRINT“S=”;:GOSUB2280:PRINT
1070 PRINT“START VALUE   =”;:Q=SD:GOSUB2280:PRINT
1080 PRINT“END VALUE =”;:Q=EV:GOSUB2280:PRINT
1090 Q=BT+LT+DT+RT+ST
1100 PRINT“TOTAL NOW =”;:GOSUB2280:PRINT
1110 PRINT“UNACCOUNTED   =”;:Q=UA:GOSUB2280:PRINT
1120 RETURN
1130 R=INT(10*(RND(1))):IFR=5THEN1130
1140 IFR>5THENR=R-5:GOTO1160
1150 R=-R
1160 IFR<0ANDR<D1THEN1130
1170 IFR>0ANDR>D2THEN1130
1180 RETURN
1190 PRINT:PRINT:PRINT
1200 FORN=1TO15:PRINT“-”;:NEXT:PRINT
1210 PRINT:PRINT
1220 PRINTTAB(10);“EXPENSE REPORT CONVERING ”;D1$;“ TO ”;D2$
1230 PRINT:PRINT:PRINT
1240 PRINT“DATE  BREAK.  LUNCH  DINNER  ROOM  SPECIAL  REASON”;
1250 PRINT“   TOTAL”
1260 PRINT
1270 FORN=1TODY
1280 L=0
1290 T$=STR$(A(N,0))
1300 PRINTLEFT$(T$,LEN(T$)-2);“/”;RIGHT$(T$,2);
1310 FORK=1TO5:L=L+A(N,K):NEXTK
1320 R=5:Q=A(N,1):PRINTTAB(8);:GOSUB2280
1330 R=6:Q=A(N,2):PRINTTAB(15);:GOSUB2280
1340 R=6:Q=A(N,3):PRINTTAB(23);:GOSUB2280
1350 R=5:Q=A(N,4):PRINTTAB(31);:GOSUB2280
1360 R=5:Q=A(N,5):PRINTTAB(39);:GOSUB2280
1370 PRINTTAB(48);
1380 IFR$(N)<>“”THENPRINTR$(N);
1390 R=7:Q=L:PRINTTAB(59);:GOSUB2280:PRINT
1400 NEXTN
1410 PRINT
1420 FORN=1TO65:PRINT“=”;:NEXT:PRINT:PRINT
1430 GOSUB900
1440 PRINTDY;“DAYS”;
1450 R=6:Q=BT:PRINTTAB(8);:GOSUB2280
1460 R=6:Q=LT:PRINTTAB(15);:GOSUB2280
1470 R=6:Q=DT:PRINTTAB(23);:GOSUB2280
1480 R=6:Q=RT:PRINTTAB(31);:GOSUB2280
1490 R=6:Q=ST:PRINTTAB(39);:GOSUB2280
1500 R=6:Q=BT+LT+DT+RT+ST:PRINTTAB(59);:GOSUB2280:PRINT
1510 PRINT
1520 GOSUB1070:PRINT:PRINT
1530 FORN=1TO15:PRINT“ - ”;:NEXT:PRINT
1540 PRINT:PRINT:PRINT:PRINT:PRINT:NULL0
1550 GOTO700
1560 INPUT“DATE OF SPECIAL   MM,DD”;MM,DD:GOSUB2250
1570 IFE=1THEN1560
1580 IFR$(N)=“”THEN1650
1590 PRINTMM;“/”;DD;“SHOWS ”;:Q=A(N,5):GOSUB2280
1600 PRINT“ FOR ”;R$(N)
1610 PRINT“CHANGE (Y)ES OR (N)O ”;:INPUTT$
1620 IFT$=“Y”THEN1650
1630 IFT$=“N”THEN1700
1640 IFT$<>“N”THEN1610
1650 INPUT“AMOUNT OF PURCHASE ”;A(N,5)
1660 A(N,5)=INT(100*A(N,5))
1670 IFA(N,5)=0THENR$(N)=“”:GOTO1700
1680 INPUT“REASON OF PURCHASE ”;R$(N)
1690 IFLEN(R$(N))>8THENR$(N)=LEFT$(R$(N),8)
1700 GOSUB900:Q=UA:PRINT“UNACCOUNTABLES ARE ”;:GOSUB2280
1710 PRINT:GOTO700
1720 INPUT“WHICH MEAL~~b~~B,~~b~~L,~~b~~OR D ”;T$
1730 IFT$=“B”ORT$=“L”ORT$=“D”THEN1750
```

```
1740 GOTO1720
1750 IFT$=“B”THENT=1
1760 IFT$=“L”THENT=2
1770 IFT$=“D”THENT=3
1780 INPUT“AMOUNT OF CHANGE (+ OR -) X.XX”;C
1790 C=INT(100*C)
1800 FORN=1TODY:IFA(N,T) <>0THENA(N,T)=A(N,T)+C
1810 NEXTN
1820 GOSUB900:PRINT“NEW ”;:GOSUB1000:GOTO700
1830 INPUT“DATE YOU WISH DISPLAYED MM,DD”;MM,DD
1840 GOSUB2250:IFE=1THEN1830
1850 R=-99
1860 Q=A(N,1):PRINT“B=”;:GOSUB2280
1870 Q=A(N,2):PRINT“L=”;:GOSUB2280
1880 Q=A(N,3):PRINT“D=”;:GOSUB2280
1890 Q=A(N,4):PRINT“R=”;:GOSUB2280
1900 Q=A(N,5):PRINT“S=”;:GOSUB2280
1910 IFR$(N) <>“”THENPRINT“FOR ”;R$(N);
1920 PRINT
1930 INPUT“CHANGE VALUE (Y)ES OR (N)O”;T$
1940 IFT$=“N”THENGOSUB900:GOTO700
1950 IFT$ <>“Y”THEN1930
1960 INPUT“B/L/D/R/S  ”;T$
1970 IFT$=“B”ORT$=“L”ORT$=“D”ORT$=“R”ORT$=“S”THEN1990
1980 GOTO1960
1990 INPUT“NEW VALUE IS  ”;K
2000 K=INT(100*K)
2010 IFT$=“B”THENP=1
2020 IFT$=“L”THENP=2
2030 IFT$=“D”THENP=3
2040 IFT$=“R”THENP=4
2050 IFT$=“S”THENP=5
2060 IFP=5ANDK <>0ANDR$(N)=“”THENINPUT“REASON OF PURCHASE”;R$(N)
2070 A(N,P)=K:IFP=5ANDK=0THENR$(N)=“”
2080 GOTO1860
2090 GOSUB900:PRINT“UNACCOUNTABLES ARE $”;:Q=UA:GOSUB2280
2100 PRINT:INPUT“REDUCE UNACCOUNTABLES TO WHAT VALUE”;T
2110 T=INT(100*T)
2120 IFT >=UATHENPRINT“** MUST BE LESS**”:GOTO2090
2130 Z=1000:R=7
2140 IFZ*3*DY >ABS(UA-T)THENZ=Z-1:GOTO2140
2150 IFZ=0THENZ=1
2160 PRINT“ITERATING BY ”;:Q=Z:GOSUB2280:PRINT
2170 FORX=1TODY
2180 FORY=1TO3
2190 IFA(X,Y) <>0THENA(X,Y)=A(X,Y)+Z
2200 GOSUB900
2210 IFUA <=TTHENPRINT:GOSUB1000:GOTO700
2220 NEXTY:NEXTX
2230 IFZ <>0THENZ=Z-1:GOTO2140
2240 GOTO2170
2250 FORN=1TODY:IFA(N,0)=MM*100+DDTHENE=0:RETURN
2260 NEXTN:E=1
2270 PRINT“NO SUCH DATE AS ”;MM;“/”;DD:RETURN
2280 Q$=STR$(Q):Q$=RIGHT$(Q$,LEN(Q$)-1)
2290 IFQ=0THENQ$=“0.00”:GOTO2350
2300 IFLEN(Q$)=2THENQ$=“.”+Q$
2310 IFLEN(Q$)=1THENQ$=“.0”+Q$
2320 IF Q <0THENQ$=“ - ”+Q$
2330 IFLEFT$(Q$,1)=“.”ORLEFT$(Q$,2)=“-.”THEN2350
2340 Q$=LEFT$(Q$,LEN(Q$)-2)+“.”+RIGHT(Q$,2)
2350 R=R-LEN(Q$)
2360 IFR >0THENPRINT“ ”;:R=R-1:GOTO2360
2370 PRINTQ$;:IFR <=-99THENPRINTSPC(5);
2380 RETURN
END
```

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Deep, Dark Secrets of the TRS-80 (Level I)

Who knows what lurks in the "mind" of the TRS-80? The Shack does know; BL does too.

Want to know how to load a machine-language cassette and take control away from the Level I ROM? How can Level II increase cassette transfer rate with software? Well, fellow T-BUG users, here are the answers you've been looking for.

Introduction

Several features of Radio Shack's TRS-80 microcomputer puzzled me for quite some time. Among these was the ability to load and execute a machine-language program. Still another was the ability of Level II BASIC to increase the cassette transfer rate from 250 baud to 500 baud.

A few months ago I purchased Radio Shack's T-BUG program. I was determined to find out how T-BUG could take control of the CPU away from the ROM. The first step was to find a way to display more memory at one time than T-BUG allows. The result was a core dump routine that displays 64 locations at a time in both hex and ASCII character equivalence. Pressing "ENTER" causes it to scroll the next 16 locations.

With the aid of the core dump, about 35 percent of the ROM was manually disassembled. Since I had no previous experience with the Z-80 or 8080 machine language, it was very tedious work. Therefore, the next step was to write a disassembler. One week later, working two or three hours a night, I finally finished the disassembler.

Now life became a lot simpler. To step through every instruction in the ROM was easy and relatively painless, but there was still no clue as to "how?" It was easy to see that T-BUG does take control of the machine—but there are no "jump" or "call" statements that can get you out of the ROM! I was beginning to think that there was some *magic* involved, when an idea came to mind: There is a way to transfer control without using a JP or CALL! Are you ready for this? RETurn!!! That's right.

One Mystery Solved

How? . . . Simple! When the computer executes a CALL, it pushes the return address onto the stack. When it executes a RET, it pops the address off the stack. Now, what would happen if you were to "modify" the address that got stored in the stack in between the CALL and the RET? Right! When the RET is executed, control would go to whatever address is then in the stack.

This is, indeed, the exact technique used by T-BUG (and any other programs that are not in BASIC). When the TRS-80 is powered up (or RESET), the stack pointer is initialized to 4200_H. T-BUG loads into addresses 4091_H to $43FD_H$. If you examine the contents of $41FE_H$ and $41FF_H$ you will see the address that was placed into the ROM's stack when the tape was loaded ($40B1_H$). Thus, when the "CLOAD" subroutine executes its RETurn instruction, control passes to address $40B1_H$ (in the T-BUG program).

So there you have it—all you have to do to write your own programs that can load and take control away from the ROM is store the beginning address at $41FE_H$ and $41FF_H$ (high-order byte to $41FF_H$) during the load. Just to get you used to this, let's try a quick, little experiment.

Enter the listing shown in Program A using the T-BUG monitor. This program will paint the video screen white (same as using the SET instruction in BASIC); wait about five seconds and return control to the ROM. (The RST 20H instruction at 4409_H is a call to a ROM subroutine that compares the contents of the DE register with the contents of HL.)

Now that you have that program in core, write it onto cassette using the following T-BUG instruction:

```
P 4400 441B
```

Now modify the locations as shown below:

```
41FE 00
41FF 44
```

Again, using the "punch" command in T-BUG, write these two locations onto the tape:

```
P 41FE 41FF
```

OK, here we go—rewind the recorder and push the MASTER RESET on the computer. Now that you are back under ROM control, enter CLOAD. The computer should come back with "READY" (as though you loaded a BASIC program). Now enter

```
4400   11 00 40          LD   DE,4000H
4403   21 00 3C          LD   HL,3C00H
4406   36 BF      LOOP1  LD   (HL),BFH
4408   23                INC  HL
4409   E7                RST  20H
440A   38 FA             JR   C,LOOP1
440C   06 05             LD   B,05H
440E   21 FF FF   LOOP2  LD   HL,FFFFH
4411   2B         LOOP3  DEC  HL
4412   7C                LD   A,H
4413   B5                OR   L
4414   20 FB             JR   NZ,LOOP3
4416   10 F6             DJNZ LOOP2
4418   C3 00 00          JP   ROM
```

Program A. This machine-language program will paint the video screen white; wait five seconds and return control to the ROM. Mnemonics are supplied for reference only.

CLOAD again. Presto! A white screen! It should stay that way for about five seconds and return control to BASIC. Isn't that something?

Applications

Now, how do we apply this knowledge? Well, there are two ways. If you wish to write a program that loads into high core (for example, my core dump routine resides at $7E00_H$), you can use the method described above. That is, using T-BUG, write the program, put it on tape, place the starting address in $41FE_H$ and $41FF_H$ as described and write that out onto the tape. Using this method, you will have to enter CLOAD twice—the first time will read in the program itself; the second CLOAD will cause it to execute.

An alternate method, but one that is a little more complex, is to write the program to execute in low core. To do this, you must keep several things in mind. First, T-BUG, which is used to enter the program, resides in low core. Therefore, you must enter the program at some address above 4400_H, block transfer it to where you want it (overlaying some or all of T-BUG) and record it on tape using your own "call" to the ROM's CSAVE routine. There is one other consideration to be aware of—you must not use address 4090_H as this is used during the cassette I/O operations and would be destroyed. (Note: The T-BUG starting address of 4091_H is not a "random" choice.)

Another Enigma—Transfer Rates

Does this seem a little complicated? I agree. However, a little later I will show you a practical example of how to use this method. In fact, it is directly tied in with mystery number two: How does Level II provide a faster transfer rate?

One of the other secrets of the Level I BASIC ROM that I stumbled upon shortly after completing the disassembler was how the cassette I/O works. Actually, the problem was: How does Level II increase the transfer speed without altering the hardware? In going through the code in the ROM for CSAVE (starting at $0F3B_H$) and CLOAD (at $0EE9_H$), I realized that the actual I/O commands were in timing loops. Adjusting the delays in the loops would increase or decrease transfer rate.

I copied the cassette I/O routines into the RAM (changing whatever addresses were necessary) and applied a highly complex, very technical, scientific algorithm to figure out the delay times (in other words—I

Program B. This program will allow the TRS-80 Level I to produce and read cassette tapes at 1000 baud. Note: This is a machine-language program—mnemonics and comments are for reference only.

```
4EC0  31 C0 40          LD   SP,40C0
4EC3  CD 40 0B    WAIT  CALL KEYIO        WAIT
4EC6  28 FB             JR   Z,WAIT         FOR
4EC8  FE 0D             CP   A,0DH            CARRIAGE
4ECA  20 F7             JR   NZ,WAIT            RETURN
4ECC  CD E9 0F          CALL CTON         TURN ON CASSETTE
4ECF  21 DE 40          LD   HL,40DEH     SET LOADER
4ED2  22 FE 41          LD   (41FEH),HL     ENTRY POINT
4ED5  11 00 42          LD   DE,4200H     WRITE LOADER
4ED8  CD 4B 0F          CALL CSAVE0         ONTO TAPE
4EDB  C3 3B 41          JP   MYRTN        GOTO HIGH SPEED WRITE
4EDE  31 C0 40    LOAD  LD   SP,40C0H     LOADER ENTRY POINT
4EE1  CD 40 0B    WAIT2 CALL KEYIO        WAIT
4EE4  28 FB             JR   Z,WAIT2        FOR
4EE6  FE 0D             CP   A,0DH            CARRIAGE
4EE8  20 F7             JR   NZ,WAIT2           RETURN
4EEA  CD F4 40          CALL CLOAD        HIGH SPEED READ
4EED  C3 EC 0E          JP   ROM1         RETURN TO ROM
4EF0  00 00 00 00
4EF4  CD E9 0F    CLOAD CALL CTON         TURN ON CASSETTE
4EF7  D5                PUSH DE
4EF8  AF                XOR  A            LOOK FOR
4EF9  CD 81 41    LOOP1 CALL READ1          BEGINNING
4EFC  FE A5             CP   A,A5H            OF
4EFE  20 F9             JR   NZ,LOOP1           BLOCK
4F00  3E 2A             LD   A,2AH        HERE'S WHERE
4F02  32 00 3C          LD   (3C00),A       THE TWO ASTERISKS
4F05  32 01 3C          LD   (3C01),A         COME FROM
4F08  CD A1 41          CALL READ8        READ IN
4F0B  57                LD   D,A            BEGIN
4F0C  CD A1 41          CALL READ8            ADDRESS
4F0F  5F                LD   E,A                FOR BLOCK
4F10  CD A1 41          CALL READ8        READ IN
4F13  67                LD   H,A            END
4F14  CD A1 41          CALL READ8            ADDRESS
4F17  6F                LD   L,A                OF BLOCK
4F18  0E 00             LD   C,00         INIT CHECKSUM
4F1A  CD A1 41    LOOP2 CALL READ8        READ A BYTE
4F1D  12                LD   (DE),A         AND STORE IT
4F1E  13                INC  DE
4F1F  FE 0D             CP   A,0DH        IS IT A CARRIAGE RETURN
4F21  20 0A             JR   NZ,NOCR      YES - CONTINUE
4F23  F5                PUSH AF
4F24  3A 01 3C          LD   A,(3C01H)    IF ASTERISK WAS ON
4F27  EE 0A             XOR  A,0AH          TURN IT OFF
4F29  32 01 3C          LD   (3C01H),A        IF IT WAS OFF
4F2C  F1                POP  AF                 TURN IT ON
4F2D  81          NOCR  ADD  A,C          ADD TO CHECKSUM
4F2E  4F                LD   C,A            AND SAVE
4F2F  E7                RST  20H          ARE WE DONE
4F30  30 E8             JR   NC,LOOP2       NO - LOOP2
4F32  E5                PUSH HL
4F33  CD E4 0F          CALL CTOFF        TURN OFF TAPE
4F36  E1                POP  HL           HL - LAST BYTE ADDRESS
4F37  D1                POP  DE
4F38  79                LD   A,C          LOAD CHECKSUM
4F39  A7                AND  A            TEST IT
4F3A  C9                RET                 AND RETURN
4F3B  CD E9 0F    MYRTN CALL CTON         TURN ON CASSETTE
4F3E  21 00 42          LD   HL,4200H     SET START ADDRESS FOR BASIC
4F41  ED 5B 6C 40       LD   DE,(406CH)   GET END ADDRESS
4F45  CD 4B 41          CALL SAVE         HIGH SPEED WRITE
4F48  C3 C9 01          JP   ROM2         JUMP BACK TO ROM
4F4B  3E 80       SAVE  LD   A,80H        WRITE LEADER
4F4D  C5                PUSH BC             OF 128
4F4E  08          LOOP3 EX   AF.AF'           BYTES OF
4F4F  AF                XOR  A                  ALL
4F50  CD A9 41          CALL RITE                 ZEROES
4F53  08                EX   AF,AF'
4F54  3D                DEC  A            LOOP UNTIL
4F55  20 F7             JR   NZ,LOOP3       DONE
4F57  3E A5             LD   A,A5H        WRITE OUT
4F59  CD A9 41          CALL RITE           BLOCK INDICATOR
4F5C  7C                LD   A,H          WRITE OUT
4F5D  CD A9 41          CALL RITE           BEGIN
4F60  7D                LD   A,L              ADDRESS
4F61  CD A9 41          CALL RITE               FOR BLOCK
4F64  C1                POP  BC
4F65  7A                LD   A,D          WRITE OUT
4F66  CD A9 41          CALL RITE           END
4F69  7B                LD   A,E              ADDRESS
4F6A  CD A9 41          CALL RITE               FOR BLOCK
4F6D  0E 00             LD   C,00         INIT CHECKSUM
4F6F  7E          LOOP4 LD   A,(HL)       WRITE OUT
4F70  CD A9 41          CALL RITE           A BYTE
4F73  23                INC  HL
4F74  E7                RST  20H          ARE WE DONE
4F75  20 F8             JR   NZ,LOOP4       NO - LOOP4
4F77  79                LD   A,C          WRITE
4F78  ED 44             NEG                 OUT
4F7A  CD A9 41          CALL RITE             CHECKSUM
4F7D  CD E4 0F          CALL CTOFF        TURN OFF CASSETTE
4F80  C9                RET                 AND RETURN
4F81  D9          READ1 EXX
4F82  08                EX   AF,AF'       LOOK FOR
```

```
4F83  DB FF     LOOP5 IN   A,(FFH)     BEGINNING
4F85  17              RLA                OF
4F86  30 FB           JR   NC,LOOP5        BYTE
4F88  06 3E           LD   B,3EH      DELAY
4F8A  10 FE           DJNZ $            COUNT
4F8C  CD F0 0F        CALL OUT0       READY FOR BIT
4F8F  06 2E           LD   B,2EH      DELAY
4F91  10 FE           DJNZ $            COUNT
4F93  DB FF           IN   A,(FFH)    GET BIT
4F95  47              LD   B,A
4F96  08              EX   AF,AF'     PUT IT
4F97  CB 10           RL   B            INTO BIT 0
4F99  17              RLA                 OF A-REG
4F9A  F5              PUSH AF
4F9B  CD F0 0F        CALL OUT0       ACKNOWLEDGE
4F9E  F1              POP  AF
4F9F  D9              EXX             RETURN WITH BIT
4FA0  C9              RET               IN A-REG
4FA1  06 08     READ8 LD   B,08H      GET 8 BITS
4FA3  CD 81 41        CALL READ1        OR 1 BYTE
4FA6  10 FB           DJNZ $-1        RETURN WITH BYTE
4FA8  C9              RET               IN A-REG
4FA9  D9        RITE  EXX             CHAR TO BE WRITTEN IN A-REG
4FAA  0E 08           LD   C,08H      8 BITS IN A BYTE
4FAC  57              LD   D,A
4FAD  CD C5 41  LOOP6 CALL ONE        MARK BEGINNING OF BYTE
4FB0  CB 02           RLC  D          IS THE BIT A "ONE"
4FB2  30 0B           JR   NC,ZERO    NO - ZERO
4FB4  CD C5 41        CALL ONE        YES - WRITE IT
4FB7  0D        CHECK DEC  C          ARE WE DONE
4FB8  20 F3           JR   NZ,LOOP6   NO - LOOP6
4FBA  7A              LD   A,D        CHAR WE JUST WROTE
4FBB  D9              EXX
4FBC  81              ADD  A,C        ADD IT TO CHECKSUM
4FBD  4F              LD   C,A          AND STORE
4FBE  C9              RET             RETURN
4FBF  06 30     ZERO  LD   B,30H      DELAY
4FC1  10 FE           DJNZ $            COUNT
4FC3  18 F2           JR   CHECK      LOOP BACK
4FC5  21 01 FC  ONE   LD   HL,FC01H
4FC8  CD F3 0F        CALL OUT1       READY FOR WRITE
4FCB  06 0A           LD   B,0AH      DELAY
4FCD  10 FE           DJNZ $            COUNT
4FCF  21 02 FC        LD   HL,FC02H
4FD2  CD F3 0F        CALL OUT1       DO THE WRITE
4FD5  06 0A           LD   B,0AH      DELAY
4FD7  10 FE           DJNZ $            COUNT
4FD9  21 00 FC        LD   HL,FC00H   OUTPUT BACK
4FDC  CD F3 0F        CALL OUT1         TO ZERO (RTZ)
4FDF  06 27           LD   B,27H      DELAY
4FE1  10 FE           DJNZ $            COUNT
4FE3  C9              RET             RETURN
4FE4 thru 4FFC must be 00

4FFD  A8
4FFE  C0
4FFF  40
```

```
6800   01 40 01      LD   BC,0140H    BYTE COUNT
6803   11 C0 40      LD   DE,40C0H    RECEIVING ADDRESS
6806   21 C0 4E      LD   HL,4EC0H    SENDING ADDRESS
6809   ED B0         LDIR             TRANSFER
680B   CD E9 0F      CALL CTON        TURN ON CASSETTE
680E   11 FF 41      LD   DE,41FFH    SET LAST BYTE ADDRESS
6811   21 C0 40      LD   HL,40C0     SET FIRST BYTE ADDRESS
6814   CD 4B 0F      CALL CSAVE0      WRITE ONTO TAPE
6817   C3 C9 01      JP   ROM2        JUMP TO ROM
```

Program C. This routine will block transfer the load/save program and store it on a cassette tape, creating a load/save production tape.

guessed). The result of this effort was a cassette load/save program that is not 250 baud like Level I, not 500 baud like Level II, but 1000 baud! A 14K BASIC Star Trek program that took 7½ minutes to load now loads in less than 2 minutes! That's what is called convenience."

1000-Baud Program

The load/save program is a good example of a self-executing machine-language program illustrating the block transfer and record method. The load/save program is shown in Program B, and the block transfer and record routine is shown in Program C. Using the T-BUG monitor, here is how to create the production tape.

1. Enter the load/save program *exactly* as it is shown in Program B.
2. Enter the routine in Program C.
3. If you desire, you may record these two programs on tape. Note: The production tape, which will ultimately contain the load/save program, cannot be reproduced, except on audio equipment. To save the programs, enter:

   P 4EC0 5000
   P 6800 681A
4. Drop in a cassette and prepare for recording.
5. Enter J 6800.

Since part of T-BUG is now wiped out, control is returned to BASIC. You now have a production tape that can be used to create tapes at 1000 baud. The tapes will each have their own "loader" (at normal transfer rate) which can read the remainder of the tape at high speed. To use the system, follow these instructions:

1. Load a BASIC program in the normal manner from cassette or keyboard.
2. Mount the load/save cassette you just created and enter CLOAD.
3. When the cassette stops (there is no other indication), put in a fresh tape and place the tape player in record mode.
4. Press "ENTER." The "loader" and BASIC program will be recorded. Control will return to the ROM.
5. To load a program produced in this manner, rewind the tape and enter the CLOAD as usual.
6. A couple of seconds after the asterisks appear, the cassette will again stop. At this point, *reduce the volume to around 5.*
7. Press "ENTER." (Note how fast the second asterisk flickers!)

If you encounter read errors, try adjusting the volume between 4 and 6. If you're still getting read errors, try cleaning and degaussing the heads of the recorder.

A last word of caution. Any changes to Program B will alter the entry point address. This program must load so that the tape "checksum" is placed into $41FF_H$ (4200_H is the first byte of the BASIC program). Therefore, the load/save program has been adjusted to produce a checksum of 40_H (the high-order byte of the entry point address—$40C0_H$). This is the purpose of the $A8_H$ stored at $4FFD_H$.

Well, that's about it for this time. As you are reading this, think about me—busily searching through my Level II ROM, converting my Level I T-BUG programs to Level II, and, in general, turning my lovely wife into a computer widow. Good luck and happy T-BUGging. ■

Author's Note: This article discusses the Radio Shack TRS-80 and features a 1000 baud cassette tape program that utilizes the T-BUG Monitor and Debugging Aid available from Radio Shack. Detailed knowledge of Z-80 machine-language, a prerequisite to using T-BUG, can be obtained from the user's manual that accompanies Radio Shack's "TRS-80 Editor/Assembler" or any Z-80 CPU Reference Manual.

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Interfacing the Elf II

Did you enjoy "The Amazing 1802" back in August? Here's more info from the same source.

Robert J. Cotter
The Johns Hopkins
School of Medicine
Baltimore MD 21205

How many times, while entering a long program on my Elf II, have I suddenly wondered if I'd missed an entry? I'd then go back again to the beginning and check each set of bytes. Or I'd move my logic tester along the address bus to see where I was, compare that with my written program and see if the contents on the display corresponded to the correct address. Other times when I would make a mistake on an entry, I'd have to step the INPUT switch from the very beginning up to where I'd made my error and correct it.

At first I considered connecting an LED to each of the address lines, but the thought of reading binary numbers while my listing was in hexadecimal was not very appealing. Finally, I decided to hard-wire decode the address lines and display them in hexadecimal. And, while I was at it, why not decode the full 16-bit addresses, so that my circuit wouldn't become obsolete when I bought that new 4K memory expansion board that is now available for the Elf II?

In this article I describe two simple circuits for decoding and displaying all 65K address locations. In addition, I have written a short program that can be used with the second circuit as an *operating system* to display any address, change its contents and step through or execute a program beginning at any location. In combination with the address decoder and display, the operating system has been invaluable as a debugging tool.

16-Bit Addressing—How It Works

By placing eight high-order bits and eight low-order bits of an address on the lines at different times in the machine cycle, the 1802 needs only eight addressing lines to transfer all 16 address bits to and from its memory. The original Elf II, which has only 256 memory locations, utilizes only the low-order bits. The high-order bits are needed for memory expansion and are generally decoded for "page selection."

Fig. 1 shows a typical *timing diagram*. Note that the timing pulses TPA and TPB appear during the different parts of the cycle when the high-order and low-order bits are on the address bus. These timing pulses can be used to latch each half of the 16-bit address. Each of the 8-bit bytes can then be separately decoded for display as two hexadecimal digits.

Circuitry

A simple 16-bit address display is shown in Fig. 2. The eight address lines are first buffered using CMOS 4050 hex noninverting buffers. TPA and TPB are buffered with 4049 inverters to provide the necessary *low* enable pulses for latching the address bits onto the four 9368s.

The 9368s are latches, decoders and drivers all in one integrated circuit, and, unlike other 7-segment decoders, they decode all 16 binary states. When the high-order address bits appear on the lines, the inverted TPA pulse causes two of the 9368s to latch and display their 2-bit hexadecimal equivalent. When the low-order bits appear, $\overline{\text{TPB}}$ latches these on the other two displays.

Once you have built this circuit, you can enter a program and see both the memory contents and the address displayed simultaneously as you input each memory byte. As mentioned before, this can be quite helpful when you enter a long program, where it is easy to miss a memory byte. Furthermore, if you have built the 1 Hz clock recommended in "The Amazing 1802" (August 1978, p. 102), you can debug a program by executing it slowly (8 seconds/machine cycle) and watching the address display.

I have found many programming errors with this circuit by noting that a memory byte was fetched from a different location than I had intended. The address display will indicate just how far a program executed successfully.

You may, however, wish to have a circuit that also gives you access to the 16 address bits, which you can then use for selecting pages of memory or for memory-mapped I/O. This can be accomplished by modifying the circuit in Fig. 2 and placing a second set of latches between the address buffers

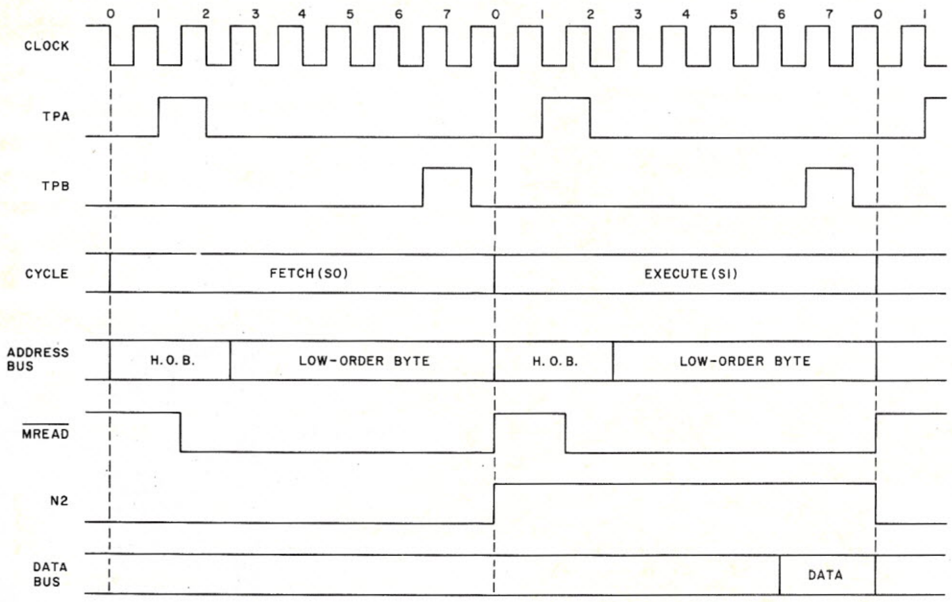

Fig. 1.

and the 9368 latch/decoder/drivers.

This circuit is shown in Fig. 3 and uses two 74100 8-bit latches. (Alternatively, four 7475 4-bit latches work just as well.) Since the 74100 is TTL logic, the latched address outputs (A0 to A15) can be connected to a number of memory boards or output devices. Circuit operation is similar to that of Fig. 2. TPA latches the high-order bits on one of the 74100s, and TPB latches the low-order bits on the other.

Note, however, that $\overline{\text{TPB}}$ now latches all 16 bits simultaneously on the 9368s, so that all of the displays change at exactly the same time. This is especially convenient when a program with the 1 Hz clock is being executed.

An Operating System

Whenever the RUN switch of the Elf II is depressed, the memory pointer always starts execution at location 00 00 in the memory. This is inconvenient if a number of programs are to be stored in different locations of the memory. While you could INPUT a GOTO command in the first few locations to start excution at any point, this would not solve the problem of correcting a single byte further along in memory or getting a listing of a program without having to step up to the beginning location.

A simple *operating system*, on the other hand, would allow the user to set the program pointer at any location in memory, examine the contents of that location, change the contents, step through the program or begin execution at that point. The *operating system* presented in Table 1 does just that. However, to make the address display useful for this system, one minor hardware change must be made.

When the *operating system* has been loaded and the RUN switch depressed, the operating program sits in a loop awaiting input from the operator. Input consists of a two-byte address location and an instruction either to examine an entry, change the contents of a memory location or begin execution. This loop results in a hopeless jumble of numbers on the address display. Since the

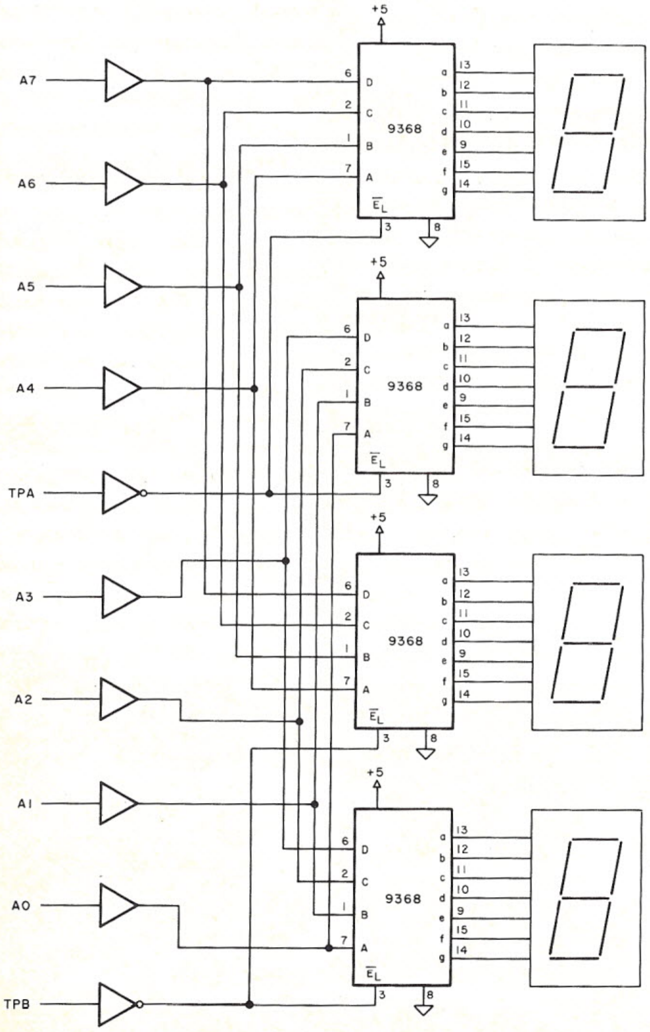

Fig. 2.

Address	Bytes	Comments
00 00 03	F8 00 B1 F8 38 A1	Set location for storage area of starting address at 00 38, using R1 as pointer.
06	E1 64	Set X = 1. Show location 00 38 on address display, and contents on data display. R1 + 1.
08 0B	7B 3F 08 7A 37 0B	Wait for INPUT switch ON and OFF.
0E	6C B2 64	Load the high-order byte of the starting address from the keyboard into R2.1 and location 00 39. Show 00 39 on address display and high-order byte on data display. R1 + 1.
11 14	7B 3F 11 7A 37 14	Wait for INPUT switch ON and OFF.
17	6C A2 64	Load the low-order byte from the keyboard into R2.0 and location 00 3A. Show 00 3A on address display and low-order byte on data display. R1 + 1.
1A 1D	7B 3F 1A 7A 37 1D	Wait for INPUT switch ON and OFF.
20	6C	Load keyboard number into register D and location 00 3B.
21 23	FB EE 32 2C	If keyboard number is EE, then go to location 00 2C.
25 27 29	7B 6C FB CE 32 2C	If not, light Q. If the keyboard number is CE, then go to location 00 2C.
2B	D2	If neither, then set program pointer at the starting location and begin execution.
2C	E2 64	Display the starting address and its contents. Increment register R2.
00 2E 30	3F 2E 37 30	Wait for INPUT switch ON and OFF.
32	39 2C	If Q is OFF, skip the WRITE step and return to 00 2C to display the next location.
34	6C	If Q is ON, write the keyboard number into the next location.
35	30 2D	Return to 00 2D to display new contents and address.
37	00	END
00 38		Storage
39		area
3A		for
3B		register
3C		R1.
00 3D		Begin user programs.

Table 1.

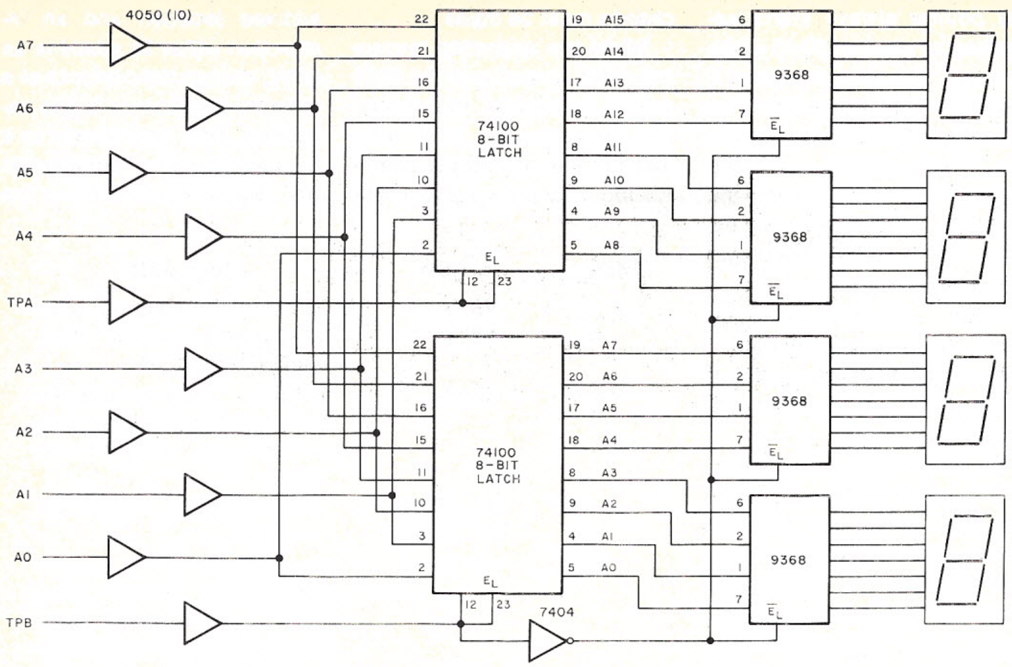

Fig. 3.

addresses of interest are those for which the contents are also being displayed, the 9368s should be enabled by a 64 instruction.

Fig. 1 also includes the timing relationships for the 64 instruction. In the FETCH cycle the 64 instruction is fetched from memory. In the EXECUTE cycle it will read a number from a location in memory and place that number on the DATA display.

During the EXECUTE cycle the N2 line goes *high*. The address display will show an address location following a 64 instruction if you replace the 7404 inverter in Fig. 3 with a NAND gate, with TPB and N2 as the inputs. The circuit is shown in Fig. 4 and includes a toggle switch to allow normal operation when you wish to watch a program execute slowly.

In the *timing diagram* (Fig. 1), the high-order address byte will be placed on one of the 74100 latches when TPA is *high*. When TPB is *high* and $\overline{\text{MREAD}}$ is *low*, the low-order address byte will be placed on the other 74100, and the contents of that location will be read. When N2 is *high*, both the DATA and ADDRESS displays are enabled.

Using the Operating System

With the toggle switch in the NORMAL position, load the operating program. Then switch the toggle switch to OPS and depress the RUN switch. The ADDRESS and DATA displays will show:

00 38 ww

giving the first location in the storage area for the operating system and its contents. Enter the high-order byte (e.g., AB) of the starting address. The ADDRESS and DATA displays will show:

00 39 AB

indicating that the high-order byte has been entered in the second storage location. Enter the low-order byte (e.g., 42). The displays will then show:

00 3A 42

If you wish to *examine* an *entry*, enter EE. The display will then indicate the full address and contents:

AB 42 xx

If you press the INPUT switch again, it will show the next address and contents:

AB 43 yy

so that you can also step through a program beginning at AB 42 and examine the contents at each location.

If you wish to *change* the entry at location AB 42, then depress the RUN switch and enter the previous address, AB 41. Then enter CE (change entry). The computer will display:

AB 41 zz

Enter the number you wish to place in AB 42 (e.g., F8). The displays will then show the new contents at that address:

AB 42 F8

and you can continue to enter numbers into each location starting from AB 42. This allows you to enter a program anywhere in the memory, as well as correcting an entry.

To run a program starting at location AB 42, enter AB 42 as before and depress the INPUT switch one more time.

Some Further Notes

The 9368s, when connected directly to common cathode 7-segment displays, draw a lot of power. This can be minimized by making all of the connections through 120 Ohm resistors as is done for the data displays on the Elf II. There seems to be no loss in brightness. Of course, all additions to the Elf II —address displays, input/output buffers, decoders, D/A converters, etc.—should be powered by a separate 5 volt supply, since the Elf II supply is capable of handling only the original circuits.

If you wish to keep the *operating system* stored in the memory, a battery backup system for the original 256 location RAM is a good idea. A circuit for doing this has been described by Joseph Weisbecker in *Popular Electronics* (September 1976).

Netronics, the manufacturer of the Elf II, has recently produced a ROM monitor for the Elf II, which contains an operating system. It takes a "software" approach to the address decoding problem and uses the DATA displays to display addresses. It also contains a cassette interface program. However, it presents only the low-order address byte on the displays and gives alternate, rather than simultaneous, readings of addresses and contents.

In addition, there are distinct advantages of having a hardwired connection to the address lines. The address decoding system described here can give memory address information during slow execution of a program, which the monitor cannot do.

However, since there are advantages to both systems, they may both be added to the basic Elf II. When the operating system described here has been loaded, entry of the address F0 00 will put the computer into the ROM monitor. ■

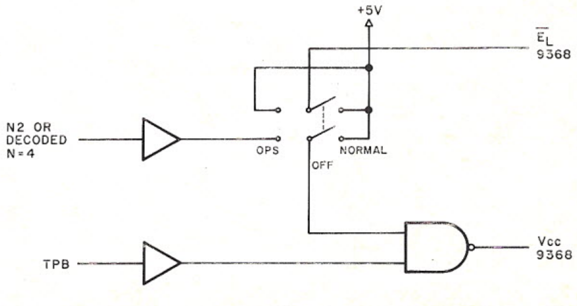

Fig. 4.

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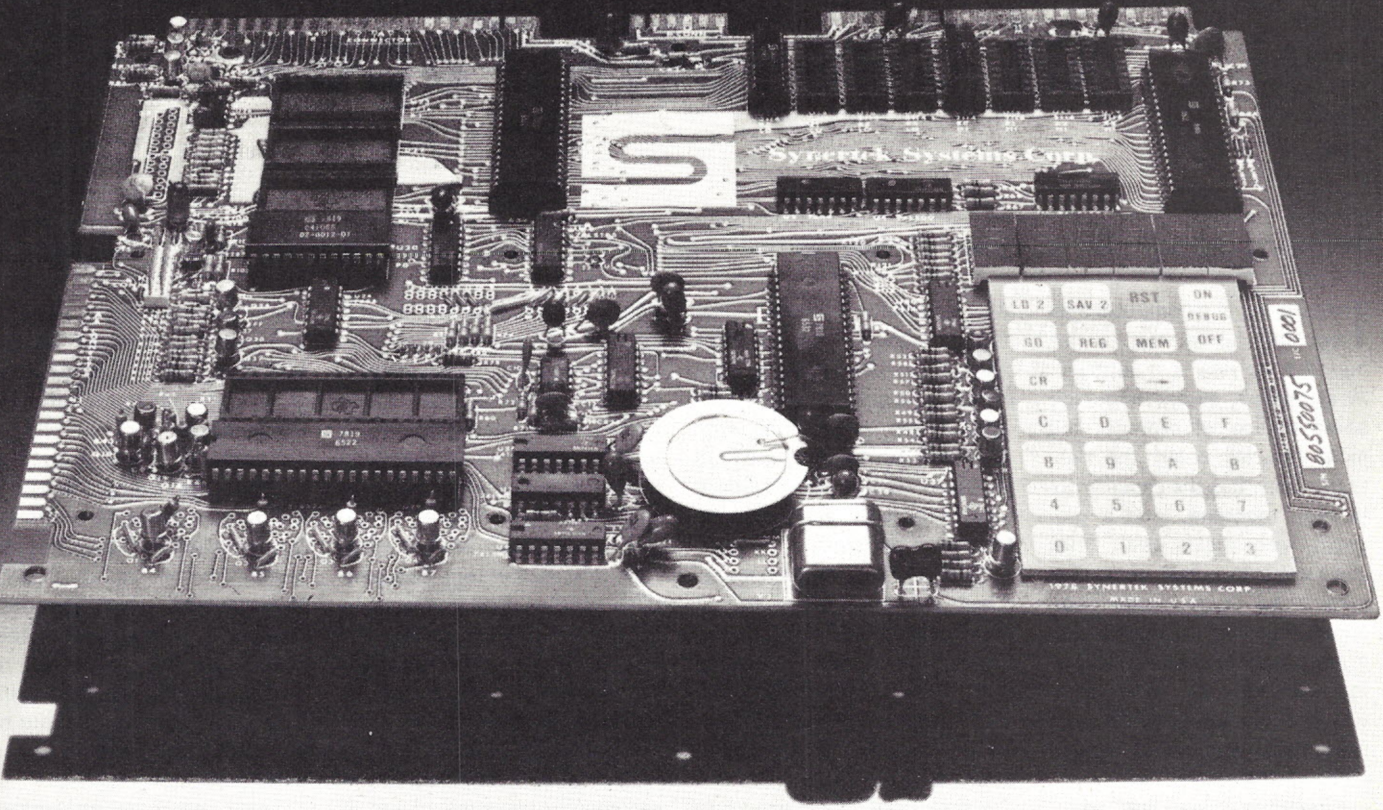

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The Care and Feeding of Cassette Tapes

Winding spaghetti requires the right techniques; so does winding, and caring for, tapes.

Investment in a computer system can range from a few hundred dollars to kilobucks. Most owners' systems include some means of storage, the most popular being the cassette. They toss the cassette into their machine, load a program, and that's that. That should be the end of it. But more than once I have seen someone trying to load a program over and over, not realizing that lack of cleanliness, which could have easily been prevented, was the problem. More on this later.

Cassettes were first introduced at the Berlin Radio Show in 1963 by a Netherlands-based firm named Philips (hence, the Philips cassettes of today). The popularity of cassettes grew because of the small size and convenience they offered over a reel-to-reel tape for similar performance. Today, of course, they play a predominant role in the field of audio recording, and cassette-manufacturing companies are continually coming out with new, improved versions of tape. So which cassette do you use for digital storage? How can you choose? What about computer-grade cassettes?

Differences To Consider

As an initial example of the existing confusion, here is a listing of cassette manufacturers at a local electronics store: Maxell, BASF, TDK, Capitol, Scotch, Memorex and Fuji. (There are, of course, other name brands in existence, and also no-name "cheapo" cassettes.) Each of these brands offers a low-noise type, a high-energy type and a chromium dioxide type. Some companies even offer a fourth type called standard, used for dictation, announcements and voice recording in general.

Then there are different tape-length designations, such as the C-30 (30 minutes playing time, both sides included), C-45, C-46, C-47, C-60, C-90, C-120, and a host of other incremental values as low as C-5 and C-10.

You don't need a computer to figure out that there are 20 to 30 or more choices of cassette storage you can buy. Multiply this by seven choices of length, and you have between 140 and 210 choices!

Before I make any suggestions, here is some information to chew on that will help make your choices easier. First, all cassette tape today is coated with ferric oxide—except for chromium dioxide-type tape—and is an extremely successful recording medium. The size of the individual oxide particles and how they coat the backing of the PVC (polyvinyl chloride—the most widely used backing for recording tape), the magnetic properties and quality control determine the differences between brands of tape.

The quality of remanence, defined as the actual magnetic signal retention as applied to a specific tape cross section, is the same for all brands. In other words, playback interchangeability in the industry exists. This guarantees that any program you buy for your cassette recorder will read out as it should. Thus, recording onto a tape and not its subsequent playback accounts for the largest amount of variables.

A comparison of low-noise tape to standard tape reveals a difference of 6 db in signal to noise from 500 Hz up (see Fig. 1). This implies that standard tapes are four times noisier than the low-noise type.

Chromium dioxide tape (CrO_2) causes wear to normal record and playback heads in the recorder. Because of this, CrO_2 tape is rapidly becoming obsolete.

Usually, cassettes with long-running times, such as the C-90 and C-120, have more mechanical handling problems than shorter-length versions.

Frequency response, though important, is common to all manufacturers for frequencies extending far beyond those needed for digital use. Every manufacturer claims that his tape is flat up to and often well beyond 15 kHz. Cassette interfaces don't yet require this extreme range.

I spoke with Don Tarbell at Tarbell Electronics, maker of the Tarbell cassette interface. Don suggested a necessary frequency range up to 8 kHz. Nevertheless, good frequency response specs will reflect good tape. Tape with flat response to 15 kHz definitely meets our needs and costs no more than a limited-range cassette (usually).

Other minor considerations include how well the tape is packaged in its case, how smoothly it runs from one spindle to the other, how effective friction reducing parts and pressure pads are. All these considerations add up to underlying differences in brands—not to mention prices.

Suggestions

Sooner or later, you will settle on one or two brands of tape

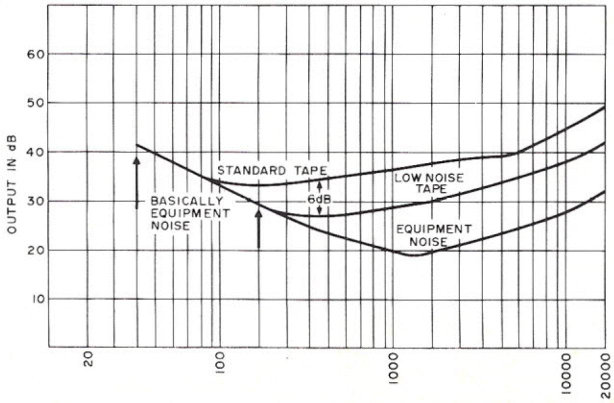
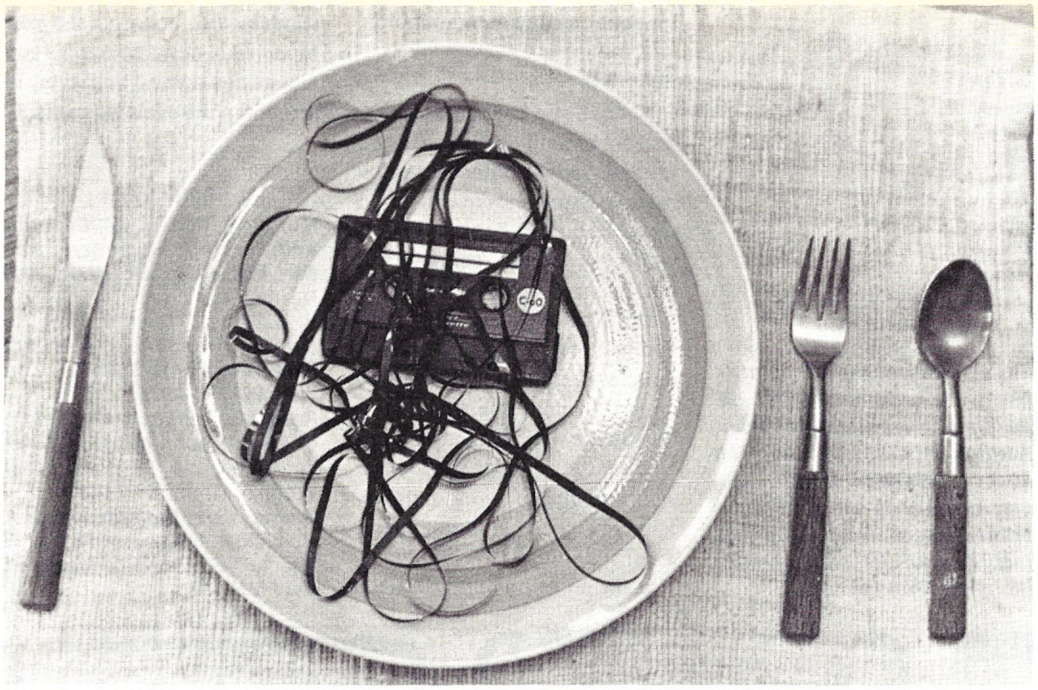


Fig. 1. Noise by ⅓ octave bands.



that are more preferable than the others for digital storage. My advice follows.

Don't use chromium dioxide tape unless you have a machine with specially hardened heads that can take the punishment. Chromium dioxide tape also requires a different bias setting (bias is an alternating current used in the recording process to eliminate distortion and increase linearity of the tape). This setting can be achieved by flicking a switch on recorders with CrO_2 capabilities.

Even if you own this type of recorder, there are ferric oxide tapes that work as well as CrO_2 tapes; they will work at more common bias settings. The common settings are usually nonadjustable and built into the recorder. Furthermore, you *don't* need the extended fidelity that CrO_2 tapes claim to have. But you do need reliability. Read on.

Substandard cassette tapes are often recognizable as unmarked and suspiciously inexpensive; these tapes should be avoided. They have no low-noise characteristics. Consequently, if you record digital information too softly or your interface is touchy, tape noise may be mistaken for data. Obviously, this is not ideal.

Two other points concerning bargain-basement types are head-to-tape contact and dropouts. In recording and playback, it is necessary that close contact between the tape head and the tape be constant. Cheap tapes often do not have smooth oxide coatings. Minute variations in the coating surface will create variations in the head-to-tape contact causing dropouts and therefore lost data.

Dropouts have other causes, too. Quality control seems to be poor with cheaper cassettes. The oxide layer is spread unevenly onto the PVC, allowing dense and sparse regions to develop. The sparse regions don't record as well (sometimes not at all), and upon playback data intermittently seems to disappear or drop out. Sometimes the oxide layer will flake off and render a tape useless, after minimal usage. Let me qualify that the aforementioned problems occur occasionally to all brands of cassette tape, but *far less frequently* to brand-name, quality cassettes.

I'd also like to mention computer-grade cassettes before going on. I've never met one I liked. Out of 200 computer-grade cassette tapes I've purchased, I've found extreme dropouts and oxide discrepancies in every single one. Just because an advertisement claims they're good for your computer doesn't mean they are.

Computer-grade cassettes are usually good cassettes that didn't make the grade during quality control. For reasons beyond me, manufacturers tend to think that if a tape can't meet audio quality specs, it's still good enough for computers and is sold in bulk to unsuspecting distributors for final packaging and sale.

Without trying to incur any manufacturer's wrath, I want to point something out: Although we in the hobby-computer industry don't require cassette tapes with full fidelity beyond the range of hearing, we are *still recording an audio signal*; and by the very nature of audio data, the tolerances must be even more exacting. That is to say—in listening to a musical passage, we can tolerate a 50 ms dropout—even to the point of not knowing it's there because of the compensatory psychoacoustic effect of the brain to fill in what's missing. For an interface, however, 50 ms dropped out of 8K BASIC will prevent it from loading properly, if at all.

I'm sure there are exceptions to this situation of bad tape being passed off for good; and I beg pardon of those companies sincerely interested in turning out cassette tape and certified data tape in cassette form that will meet quality computer specs at 1 7/8 ips.

This leaves us with low-noise and low-noise/high-energy tapes. There are minor differences between the two, such as the amount of signal you can record. High-energy tapes can handle a higher recording level before tape distortion sets in (about 3.5 db as compared to standard tape). In many cases, the cassette electronics will distort before the tape itself does. Nevertheless, some people record their tapes to saturation. At the saturation point, no increase in record drive will cause the tape to accept any more magnetic information (see Fig. 2).

If you try to increase the record input, you will merely increase distortion of the data you are recording. You can achieve a similar effect without the chance of distortion by merely playing back at a louder volume. If you are one of those who record as hot as they can, consider low-noise/high-energy tape.

Now, it seems, we've narrowed it down a bit. Simply stated, a good low-noise or low-noise/high-energy type cassette should be used—low-noise tape most of the time, or low-noise/high-energy tape if you like to record with your needle in the red. (Don't feel guilty, I'm often slightly in the red, too . . . high-energy tape has saved my neck on several occasions.)

The benefits of either type for fewer dropouts, smoother coating and higher quality control will become evident. As to length—I never recommend any cassette over 60 minutes long, both sides inclusive (C-60). This is because the longer-play cassette uses thinner tape—as thin as .5 mil—and will increase the mechanical problems, tape stretching and uneven winding (which will cause tape deterioration). Furthermore, it is generally harder to splice. If your cassette machine has ever "eaten" your cassette, I'll lay odds it was a C-90 or longer.

Concerning tape problems, I do not want to mention any specific brands. I have heard some bad words said about one of the top name brands; but until I've conducted more tests, I'll keep my mouth shut. After speaking with several other hobby-computer users, I will say we all agreed that Maxell UD and Memorex MRX-2 yielded excellent results. In any case, if you are having a problem with any brand, switch immediately to another brand.

A rule of thumb in the United States is that a more expensive product will yield better results. Competition is hot and heavy and prices are generally close for equal quality among brands.

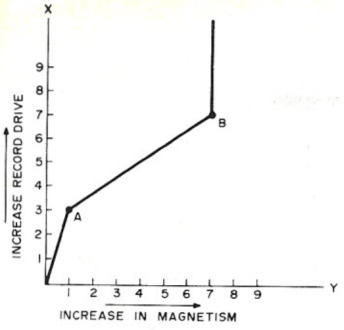


Fig. 2. The saturation point (x and y are arbitrary values, depending on type of tape). Point A represents the beginning of a linear increase of output vs input; point B is the saturation point, where increasing the record input will not increase the imprint on the tape.

Summary

Almost any cassette recorder can benefit by using good tape. A bad recorder will show marked improvement with good tape. Use bad tape and the world's greatest recorder will not be able to load your program. There is no reason to spend more than $1000 on your computer system and then go cheap on cassette storage. A few bucks will go a long way in helping you keep your cool. And it might be a long time before you get that dual floppy disk!

Make sure you peruse Part 2. It deals with how to keep your tapes like new, splicing techniques and some (I think) very interesting, little-known facts.■

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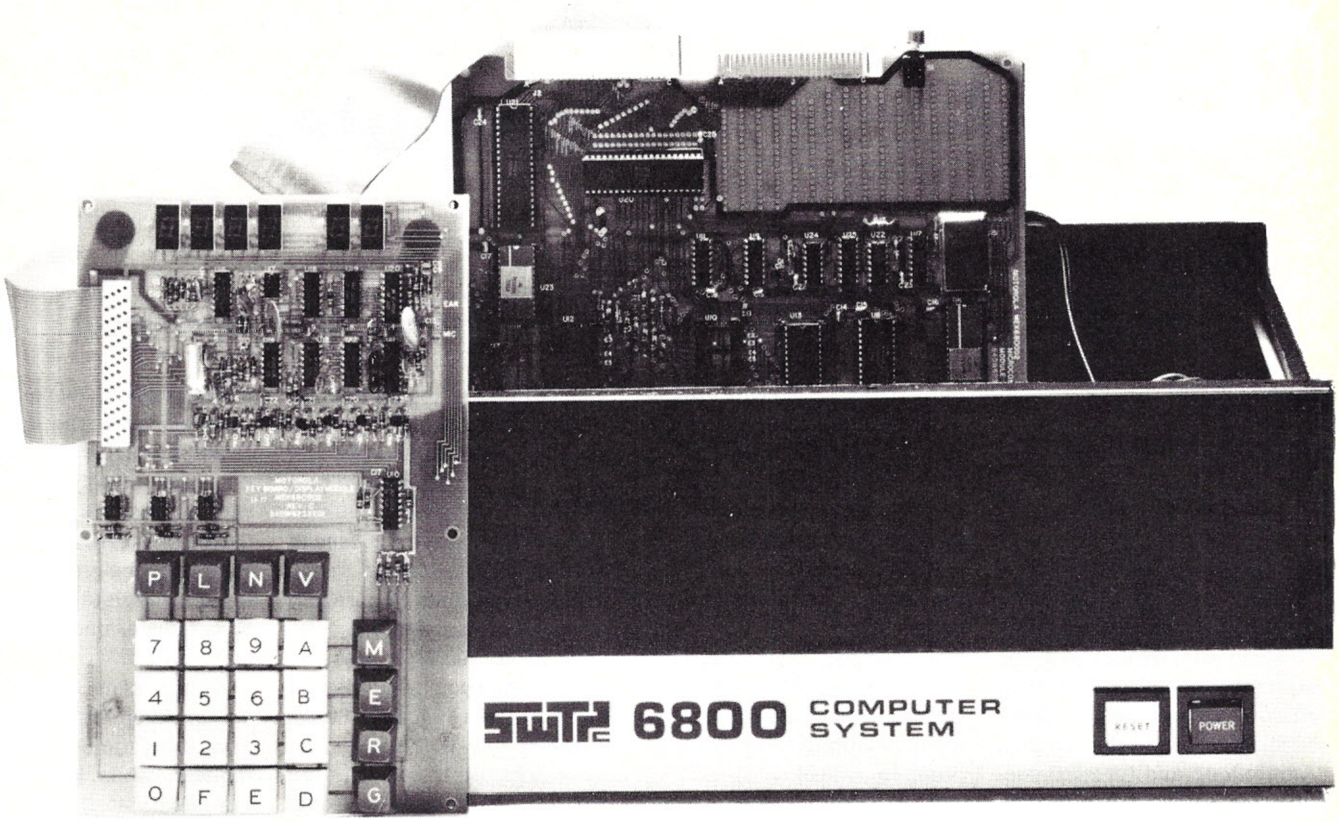

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KILOBAUD KLASSROOM NO. 15

Computer I/O III

This is the third Klassroom session dealing with computer input-output.

Peter A. Stark
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Mt. Kisco NY 10549

Two months ago we started our discussion of computer input and output (I/O) circuits. To begin with, we looked at the external connections to a computer—serial and parallel ports, serial ASCII character coding, current loop and RS-232C connections and handshaking with a parallel port.

Now it's time to see how the port connects to the microprocessor.

Introduction

Fig. 1 shows in simple form how a device connects to a microprocessor through a port. The port is part of an interface, which connects to the processor's data, address and control buses. Under program control, the processor can output data to output ports, or input data from input ports.

In addition, the port may have handshaking control signals that connect to the I/O device as well and provide Data Ready and Data Accepted signaling between the two. In most cases, these handshaking signals are in addition to the data lines in the port, but sometimes one or two of the data lines may be used for that purpose.

A microcomputer can provide an I/O port in one of three ways.

1. The port may exist right on the processor IC, in the form of several pins that can provide input or output directly under program control.

2. A port may connect to the buses in the same way as memory does, and may be programmed as if it were memory. This is called *memory-mapped* I/O.

3. The port may connect to the buses, but be controlled by one or more special I/O control lines from the processor.

Let's look at each of these in turn.

Direct Microprocessor I/O

The simplest example of I/O directly from the processor IC is on the SC/MP microprocessor manufactured by National Semiconductor.

Fig. 2 shows the I/O portion of this processor, which involves two registers and seven pins. Internally, the Status register and the Extension register are two eight-bit registers, which can be manipulated by a program or by external events.

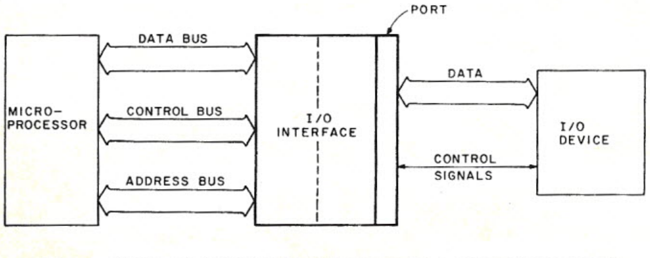

Fig. 1. How an I/O device connects to a microprocessor.

The Status register is used to hold information about things that the processor is currently working on. Five of its eight bits connect to external pins, as shown. The two bits connected to pins 17 and 18 (called Sense A and Sense B lines) can be used as inputs; if these pins are grounded, the two corresponding bits in the register become 0, or if they are brought to near +5 volts, the two bits become a 1. A program can then sample these bits at any time.

The rightmost three bits of the register connect to pins 19, 21 and 22 (called Flag 0, 1 and 2) and are used as outputs. When the processor, in response to a program, stores a 0 or 1 into the appropriate stage of the register, the output pin goes, respectively, to ground or +5 volts.

The Sense lines can be used to sense external events, while the Flag outputs can operate outside equipment. For example, the SC/MP Applications Manual shows a simple electronic door lock, where the Sense line monitors a switch used to enter a combination, while the Flag lines control LED indicators and an electric lock mechanism.

Pins 23 (called SOUT or Serial OUT) and 24 (called SIN or Serial IN) are specifically intended for serial I/O, as in driving a teleprinter or CRT terminal. In normal operation, these pins are isolated from the Extension register, which can be used for purposes other than I/O. But when a special SIO (Serial Input-Output) instruction is performed by the program, the Extension register becomes a shift register and shifts to the right one bit.

At the same time, the bit coming in on the SIN pin shifts into the leftmost bit of the register, while the bit in the rightmost bit of the register goes to a latch flip-flop, whose output goes to the SOUT pin. This flip-flop then holds the bit even if the Extension register is used for something else in the meantime.

You will remember in our discussion of ASCII serial data last month that a shift register usually does the conversion between parallel and serial, and that the least significant (rightmost) digit is sent first. As you can see, all of this is easily done right inside the SC/MP.

The SC/MP is actually a good example of internal processor I/O circuits. It was designed to be inexpensive to use in small systems, and so having some simple I/O functions right in the processor IC is a good idea. Keep in mind, though, that in most cases some sort of external buffering will be needed to isolate and amplify the signals on these I/O pins. For instance, the current loop or RS-232C circuits we discussed last month would be needed between the processor's SIN and SOUT pins and a teleprinter or

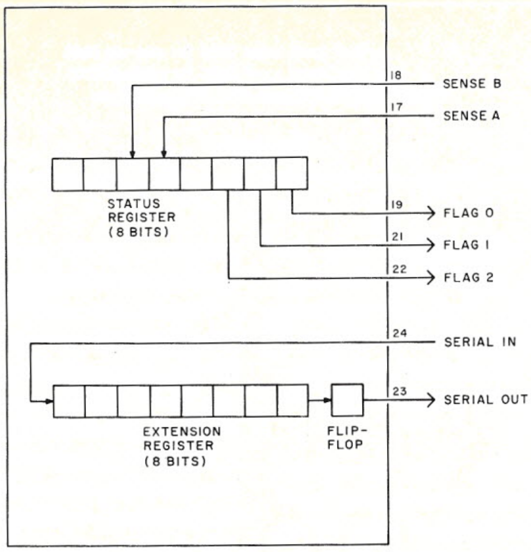

Fig. 2. The SC/MP from National Semiconductor has seven I/O pins.

CRT terminal.

There are other microprocessor ICs that have similar I/O capabilities. Some, such as the Intel 8085, provide only one or two I/O pins and need other circuitry for more complex uses; others may provide a complete eight-bit port or even more.

A good example of a processor with a complete port is the 8048/8748/8035 series from Intel. In fact, these processors have three ports each!

Fig. 3 shows the I/O connections of these processors. The three ports are Port 1, Port 2 and one called the "Bus Port." Ports 1 and 2 can be used either for input or output; they can even be used alternately for one or the other, or split up so that some bits are inputs and others are outputs. The Bus Port, on the other hand, can't be split up in that way. But it, too, is bidirectional.

All this is very nice, but let's consider the bad points of having so much I/O circuitry inside the processor chip.

Let's think about it from the point of view of IC pins. Most microprocessors have 40 pins. This applies to the popular processors such as the 8080, Z-80, 6502 and 6800, and most others as well. A few more limited ones have only 28 pins, and only a very few new ones, such as the TMS9900 or the MC68000, have 64 pins.

When you think about it, the more pins an IC has, the more complex and expensive it is going to be—both to make and to use. Forty pins is about as much as most manufacturers want to tackle, and the extra 24 pins on the MC68000 or TMS9900 must add to the price.

So, if you are going to be limited for practical reasons to 40 pins or less, then adding seven I/O pins, as done on the SC/MP, or 24 pins, as on the 8048, means something else has to go. In the case of the SC/MP it was four address bus lines. In the 8048 series, the entire data and address buses have been removed.

Keep in mind that the purpose of putting I/O ports or lines directly on the processor IC is to save money by eliminating external I/O circuits. This is especially important in simple, but high-volume, applications such as microprocessor-controlled appliances or instruments. In these cases speed may not be important, and the amount of memory may be small. Hence it may be possible to share the same lines for more than one type of signal or even eliminate address lines in the address bus altogether.

As an example, let's look at the SC/MP, whose address bus consists of only 12 lines. It uses a full 16 bits for addresses, but the other four are placed onto the data bus at a time when it is not being used for anything else (this is called multiplexing).

In simple applications, where a small amount of memory is required, the 12-bit bus can specify up to 4096 memory addresses, which should suffice for most high-volume uses. Only if more memory is required do we need to latch the other four bits into a separate set of flip-flops. So for most cases, the extra four bits are not needed. Moreover, the SC/MP is slow enough that enough time exists to squeeze the extra address bits onto the data bus.

The 8048 is another example. This is a processor that has 1024 locations of mask programmed ROM and 64 locations of RAM right on the same chip. (The 8748 is similar but has EPROM rather than ROM memory).

For many applications, the 8048 or 8748 may have enough of its own memory that no other external memory is needed. In that case no data or address buses are needed either, and the extra pins might as well be used for I/O. This makes these ICs practical for simple, inexpensive controllers in high-volume products where the 8748 would be used during initial product design and the much cheaper 8048 for the final mass production run.

Now we come to the reason why the third port is called a Bus Port: normally it is an I/O port, but in cases where more memory is needed than is available on the chip itself, it becomes an address and data bus. But since it has only eight bits, four more address bits (for a total of 12) are multiplexed onto Port 2 and . . . you get the idea—using a chip such as this one for large computer systems is not a good choice.

Memory-Mapped I/O

The second method of connecting a port to a processor is to make it look like memory. Memory-mapped I/O interfaces can be used on any processor, including those that have special I/O circuits and instructions. But for some, such as Motorola's 6800 or MOS Technology's 6502, it is the only way since they have no circuits or instructions specially intended for I/O operations.

Fig. 4 shows a simple memory-mapped output port. At the bottom, we have an address decoder just like that used in memory decoding, except that it may have to decode all, or almost all, of the address bits. (You may want to review Kilobaud Klassroom Nos. 10 and 11, which discussed decoding the address bus.) When a par-

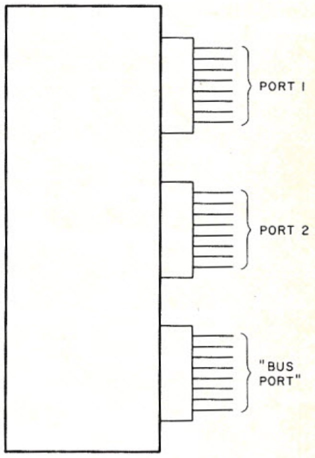

Fig. 3. The Intel 8048, 8748 and 8035 have three eight-bit ports.

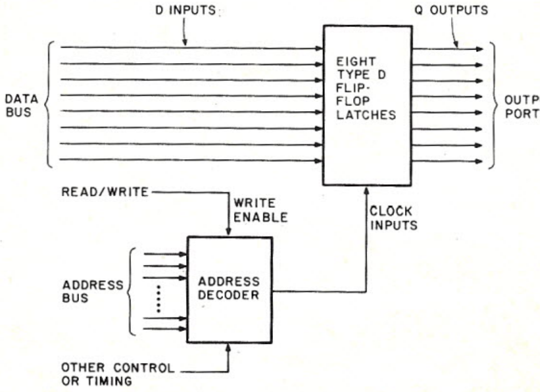

Fig. 4. A simple memory-mapped output port.

ticular address or group of addresses is called for, this decoder provides a short output pulse that goes up to eight type D flip-flop latches.

These latches have their D (Data) inputs connected to the data bus (probably through buffers of some kind) and constantly monitor the goings-on on the bus. But they only latch information when a clock pulse arrives from the decoder. When that happens, they grab whatever data is on the data bus and provide an output to the port, which is then held there until the next time that address is selected.

From the central processor's point of view, memory-mapped I/O is simple. No additional circuitry is needed inside the processor chip, since the output port looks just like, and is programmed just like, a memory location. Whenever the processor wants to output binary data to the port, it follows the same procedure as if it were writing it into some memory location. Only the external circuitry knows that the location addressed is an output register, rather than an actual location in memory. For this reason, any processor capable of operating with external memory can use memory-mapped I/O.

A memory-mapped input port is very similar, but as Fig. 5 shows, the flip-flop latches are replaced by a set of Tri-state buffers (and the address decoder must be wired so that it responds only on a read). Data from the input port is gated into the data bus only when the computer does a read from the "memory address" the decoder is wired to accept.

But, of course, there is a slight problem. If a processor has a 16-bit address, it has room for 65,536 memory addresses. If some of these are used up for I/O, then the actual memory must be smaller.

Although this seems like a small price to pay, in some popular computers it has proven to be a problem. Take, for instance, the Southwest Technical Products M6800 computer. In this system, provision is make for eight I/O ports, and each is assigned four addresses (we'll see why in a moment). Thus 32 addresses are used up for I/O, making it seem as though the rest—65,504—are left over for memory.

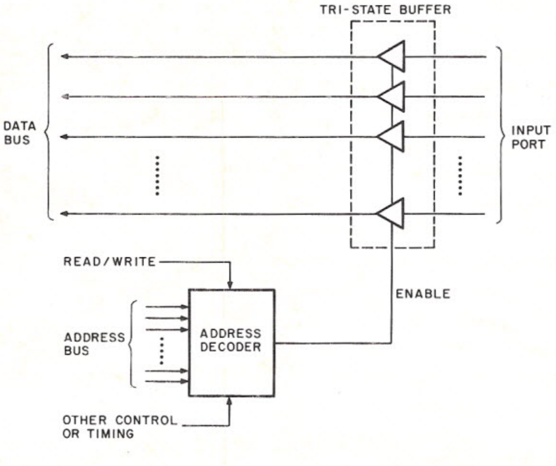

Fig. 5. A simple memory-mapped input port.

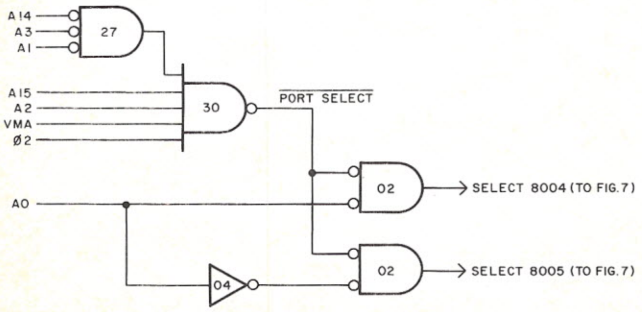

Fig. 6. Partial address decoder for addresses 8004 and 8005.

10xx xxxx xxxx 0100 for address 8004
and 10xx xxxx xxxx 0101 for address 8005,
where x stands for don't-care, undecoded bits.

Example 1.

In reality, there are several reasons why the memory must be much smaller. First of all, the decoding for I/O ports follows the same rules as decoding for memory. For instance, if incomplete address decoding is used, addresses are wasted. But address decoding for I/O is more expensive than for memory. This is because the decoder for a memory block, even with full decoding, may only have to accept three or four address input bits. If 8K memory blocks are used in a 64K computer, only eight blocks are possible, and only three bits are needed to select one block.

On the other hand, if an output port has a single address, all 16 bits have to be decoded to separate that address from all others. Decoding a 16-bit address, and doing it fast and inexpensively, is not easy, and the temptation is not to do it.

As an example, the SWTP computer takes a shortcut and only decodes ten bits. For instance, the serial I/O port has a hexadecimal address of 8004, but the actual binary address of that port need only be

1000 xxxx xx00 0100

where each x stands for a "don't care" bit that is not decoded.

If all of the xs are 0, then the hexadecimal address is 8004. But if they are all 1, then the address becomes 8FC4, and many other addresses are possible if the xs take on various combinations of 0 and 1.

So the 32 addresses have grown to take up almost 4K of memory—from about hexadecimal 8000 to 8FFF, limiting the maximum to 60K (and actually less, but for other reasons).

There is a second reason why complete address decoding for I/O is inconvenient. Suppose you do it . . . then what? Memory blocks come in multiples of a K (1024) locations. How do you chop 32 locations out of a 4K or 8K memory board? What you wind up doing is paying for the full memory, but then having to install additional circuitry to prevent part of it from working. This complicates memory board design and is seldom done. So only partially decoding an I/O address certainly makes the job easier, even if it does reduce the maximum memory size.

A third problem associated with memory-mapped I/O is the choice of addresses. In the SWTP system I/O is located starting at address 8000, which is right in the middle of the possible 64K addresses (this dates back to a Motorola decision and was not SWTP's idea). Hence the computer can only get 32K memory locations in one continuous chunk; although it is possible to have as much as 52K of RAM and ROM, the rest must be located in a different part of memory and so cannot be used together with the lower 32K.

In my system I have 40K—32K in lower memory and another 8K in upper memory. I solve the problem by putting most programs in the separate 8K memory and using the entire 32K memory only for data, but that is not always a satisfactory solution. Ideally, the "locations" for I/O should be placed either at very low or very high addresses, so that as much real memory as possible can be put in.

Experiment #65
Parallel Port with Handshaking

Problem: To really be useful, a parallel port needs not just

```
STEP 1: INPUT FROM ADDRESS 8005
STEP 2: IF NOT READY, RETURN TO STEP 1
STEP 3: INPUT DATA FROM ADDRESS 8004
STEP 4: WRITE TO ADDRESS 8005
STEP 5: CONTINUE
```

Example 2.

the eight data lines, but also some handshaking (which we described last month). How is this done with a memory-mapped I/O port?

Solution: The answer is actually fairly simple—you set up three ports: the eight-bit data port and a pair of one-bit ports just for the handshaking. If you do it right, you can share some of the circuitry between the three ports, so that the complete circuit is not much more complicated than just the data port itself.

Theory: The circuitry can be divided into two parts—the address decoding and the actual port circuitry.

Let's design an actual circuit that might be used with a Motorola 6800 processor to input parallel data from the paper-tape reader we described last month. (You may find it useful to dig out last month's Kilobaud Klassroom and look at Fig. 4 to refresh your memory on the handshaking system we used with the tape reader.) Let us assume that partial address decoding is good enough for us and that we want this port to be at memory location 8004. Since we need more than just the eight-bit data port, we also have to assign addresses for the two handshaking ports. Since handshaking requires both input and output, we can take a shortcut and use the same address—and decoder—for both. We will select address 8005 for the handshaking circuitry.

Fig. 6 shows a simple decoder that would decode just six bits of the address as shown in Example 1.

Since these two addresses differ only in A0, the last bit, we use common circuitry for the other five bits. We take the three bits that should always be 0 (A14, A3 and A1) and feed them into a 7427 NOR gate at the top, whose output will be high when all three bits are 0. (The AND symbol with circles on the inputs means that all inputs must be low for the output to be high; see "Is It High or Low," p. 56, in the May 1977 issue of *Kilobaud*, the same issue that carried Kilobaud Klassroom No. 1, for a more detailed explanation if you're rusty on this.)

This high level is then combined with the two bits that should be a 1 (A15 and A2), as well as with two 6800 control signals called VMA (Valid Memory Address) and Ø2 (Phase 2), which go positive during the time when a valid memory or I/O operation is supposed to occur. (We will take a more thorough look at control signals such as VMA and Ø2 next time.)

As a result, whenever either address 8004 or 8005 is selected by the processor, the output of the 7430 gate goes low since all its inputs are high. This signal can be called $\overline{\text{PORT SELECT}}$, since it goes on whenever either of the two addresses associated with this port is called for.

The $\overline{\text{PORT SELECT}}$ is then gated with A0 as well as with an inverted $\overline{\text{A0}}$ in two 7402 NOR gates, whose outputs show which of the two addresses were called for by a short positive pulse output. On address 8004, the top 7402 gets two low signals, and so its output goes high; on address 8005, the bottom 7402 gets two lows, and so it provides a high output. Keep in mind that this circuit provides only partial address decoding, so there will be many possible addresses besides 8004 and 8005 that will also provide output pulses from these two gates.

Fig. 7 shows the rest of the input port. There is an additional signal used here, the R/$\overline{\text{W}}$ or Read/Not Write signal from the microprocessor, which is high or positive whenever the processor is inputting from memory or I/O, and low when it is outputting. When the processor tries to input from the port, it executes an instruction that says, "read from location 8004."

At this point, the R/$\overline{\text{W}}$ signal goes positive just as the Select 8004 signal goes positive, with the result that gate 1 provides a low output pulse to the eight 8097 Tri-state input buffers. This lets the data from the paper-tape reader get to the data bus, so that the microprocessor receives the data.

The rest of Fig. 7 is the handshaking circuitry. Whenever the tape reader has a character, it makes the DATA READY line high. If the microprocessor does an input from address 8005, that signal will go through the lower 8097 buffer to one of the data bus lines. This one-bit input port allows the microprocessor to test the DATA READY line.

On the other hand, if the processor does a write to address 8005, both inputs to gate 3 will go high, and the gate outputs a short negative-going pulse on the $\overline{\text{DATA ACCEPTED}}$ line. You may remember from last month's Fig. 4 that this was needed in the tape-reader interface to reset the DATA READY flip-flop.

We haven't talked much about programming yet, but it might be a good idea to mention quickly how the program would work for this interface. Suppose that the computer is supposed to test for input data, input it if present or wait for it if not. The program—ignoring the question of the language it is written in—might look like the short program in Example 2.

In step 1 we do a read from location 8005, which sends the DATA READY bit to the data bus. In Step 2, the microprocessor looks at it to see whether it is a 0 or a 1. If it is 0, indicating that the data is not there, it returns back to step 1 and repeats. If the data is already there when the computer gets to this part of the program, then it goes right on to step 3; otherwise, it will wait here as long as needed until the data arrives. This part of the program is often called a *wait loop*.

When the DATA READY bit finally arrives from the tape reader, the processor inputs the data from location 8004 in step 3 and follows that up with a write to location 8005. Notice that it doesn't particularly matter what it sends to 8005; the port circuits don't really look at the data bus anyway. Just

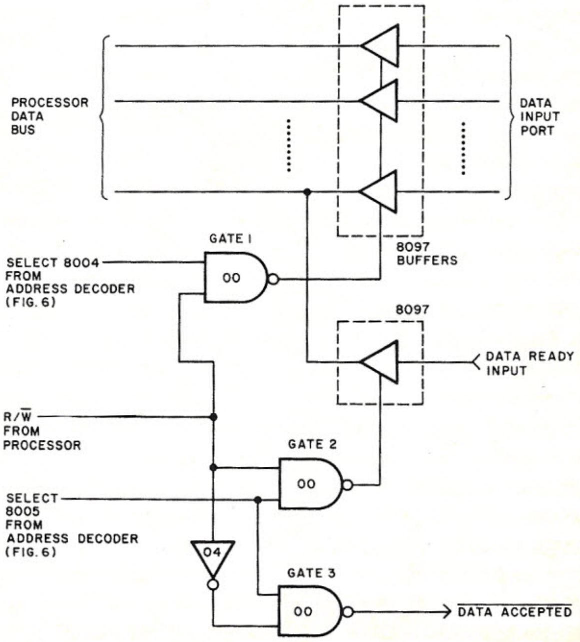

Fig. 7. Data and handshaking circuits.

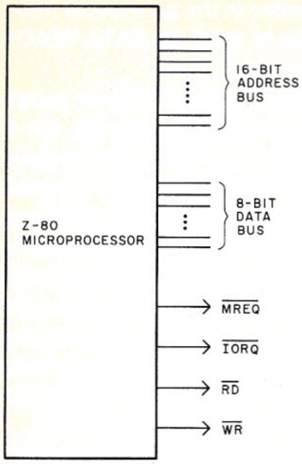

Fig. 8. I/O and memory control lines of the Z-80.

doing a write to location 8005 is enough, because this sends out the $\overline{\text{DATA ACCEPTED}}$ signal to the tape reader, which resets the READY flip-flop in the reader and removes the DATA READY signal.

If you look at last month's tape-reader circuit, you will remember that the READY flip-flop stays set until the $\overline{\text{DATA ACCEPTED}}$ signal is received. This means that if the computer isn't quite ready for data from the tape reader, the DATA READY signal will stay there for some time. Of course, if the tape is moving through the reader so fast that the character is long gone by the time the computer does the input, then there will be an error. But if the computer is reasonably fast, it should have plenty of time to get the character before the next one comes.

There are several variations on this circuit that we could try. For instance, we could remove gate 3 completely and use the output of gate 1 as the $\overline{\text{DATA ACCEPTED}}$ signal. In this way, the port would send out a $\overline{\text{DATA ACCEPTED}}$ automatically as soon as the processor read the input data. This is done fairly often, but I wanted you to see the full circuit because it points out one idea: It is possible to use one address for two ports. In this case, address 8005 could be used for both an input port and an output port, because the R/$\overline{\text{W}}$ line determines which one gets addressed.

This particular interface requires only two addresses, one for the data and one for handshaking; but sometimes more addresses are needed for a port. This explains why the SWTP computer sets aside four addresses for every port. It is something that is done fairly often.

Procedure: I'm not sure how practical it is for you to actually do this experiment, but if you have the time—and patience—go ahead.

Wire up the circuit in Figs. 6 and 7 and test it by connecting LEDs to the data bus lines and to the $\overline{\text{DATA ACCEPTED}}$ line. Use wire jumpers to provide the needed input signals. You have most of the parts except for the 7427 three-input NOR gate and the 7430 eight-input NAND gate, but you can use two-input gates by simply eliminating some of the input connections.

By the way, if you do have a 7427 triple three-input NOR, keep in mind that by connecting two of the inputs together you make it into a two-input NOR; thus all three NOR gates in Fig. 6 can be made out of one IC. By connecting the two inputs of a 7400 NAND together it becomes an inverter, so the same 7400 IC used in Fig. 7 for gates can also provide the inverter in Fig. 6. If you then eliminate gate 3 in Fig. 7, you can build the complete port from five ICs (counting two 8097 buffers).

Later we will see some specialized ICs that provide all of the circuitry in one chip, but for now we have to move on.

Processors with I/O Instructions

As opposed to the processors that require memory-mapped I/O, there are quite a few that have special instructions and circuitry to do I/O separate from memory operations. The two most popular are the 8080 and the Zilog Z-80.

The Z-80 illustrates the idea best. As you can see in Fig. 8, there are four control lines involved. For all memory operations, the $\overline{\text{MREQ}}$ or Memory REQuest line goes from its normally high voltage level to a low; the bar over the name means, as usual, that this signal is active low, that is, it goes low when active.

For all I/O operations, on the other hand, the $\overline{\text{IORQ}}$ or I/O ReQuest line gets a low pulse. In addition, the $\overline{\text{RD}}$ and $\overline{\text{WR}}$ lines indicate whether this is a read from memory or from an input device or a write to memory or to an output device. They, too, go low when active.

In order to do an input or output operation, the program has to include a special I/O instruction. The Z-80 has several such instructions, but the two simplest and most concise are the IN and OUT commands.

The IN instruction works like this. Part of the IN instruction is a number from 0 to 255 that specifies one of 256 ports. When the computer executes the IN, it sends the eight-bit port number out on the eight least significant address lines, A7 through A0, and holds it there. A fraction of a microsecond later, it puts a pulse on the $\overline{\text{IORQ}}$ and $\overline{\text{RD}}$ lines. The input port must have a decoder that is enabled by the $\overline{\text{IORQ}}$ so that it decodes the address and puts the input data onto the data bus before the $\overline{\text{RD}}$ pulse disappears. At the end of this $\overline{\text{RD}}$ pulse, the processor will accept the input data from the port.

The OUT instruction is similar: When it is done, the processor outputs the port number on A7 through A0 and again turns on the $\overline{\text{IORQ}}$ line. A moment later it outputs data on the data bus and sends out a $\overline{\text{WR}}$ pulse. The output port circuits have to decode the port address and grab the data off the data bus at the tail end of the $\overline{\text{WR}}$ pulse.

As you can see, the address bus is used during these operations to provide an I/O port address. We can think of this as a device code, which specifies what device is being addressed. The data bus, on the other hand, is used in exactly the same way as during memory reads or writes—it carries eight-bit data.

Use of separate I/O instructions like this has two main advantages—first of all, it separates I/O addresses from memory addresses, so that the maximum 64K of memory can be connected without interference from I/O. This certainly makes a difference in larger systems, although it may not mean much in a small computer that may only have a few K of memory in the first place.

But a second advantage is that since the I/O address only has eight bits, I/O address decoding is much easier to do than if the full 16-bit memory addresses had to be decoded. In fact, if the system only had a few I/O ports, it might be possible to just decode one or two address bits. No decoding would have to be done at all if there were only one input port and one output port, since then we wouldn't care what the I/O device code was. (Remember, an input port can share an address with an output port.)

The popular 8080 processor follows the same basic idea as the Z-80 but is not nearly as di-

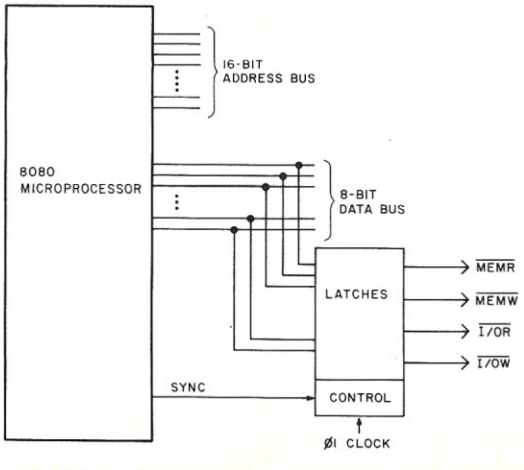

Fig. 9. I/O and memory control lines in 8080 systems.

rect. Because the pin connections for the 8080 are different from those of the Z-80, there are no $\overline{\text{MREQ}}$, $\overline{\text{IORQ}}$ or $\overline{\text{RD}}$ signals coming out of the 8080. Instead, this information is multiplexed onto the data bus between other operations. Hence it must be latched off the bus and decoded by external circuits.

Fig. 9 shows the basic circuit. As with the Z-80, there is a 16-bit address bus and an eight-bit data bus. In addition to its other connections, the data bus also goes to a group of latches, which are controlled by a SYNC signal from the processor, along with a clock pulse called Ø1 or phase 1. (More on clock phases some other time.)

The combination of SYNC and Ø1 triggers the latches at the precise instant to catch the control signals from the data bus. The four outputs from this external circuit are $\overline{\text{MEMR}}$ (MEMory Read), $\overline{\text{MEMW}}$ (MEMory Write), $\overline{\text{I/OR}}$ (I/O Read) and $\overline{\text{I/OW}}$ (I/O Write).

The 8080 has the same IN and OUT instructions as the Z-80 has, and their operations are fairly similar. In each case, when the instruction is done, the processor outputs the port address on the least significant eight bits of the address bus and then puts a pulse on either the $\overline{\text{I/OR}}$ or $\overline{\text{I/OW}}$ line. Port address decoding circuits must then decode the address and either send data to the data bus or accept data from it.

Now, let me ask you a question: What kind of circuitry would you need for a port complete with handshaking? Stop right here and think about it for a minute.

If you are reading this paragraph, you probably didn't think about it long enough, so wait a little more. No cheating.

OK, let's go on. If you came to the conclusion that there is little difference in the port circuits between the Z-80 or 8080-type I/O approach and the memory-mapped I/O, you are exactly right. The only important difference is that with memory-mapped I/O we must decode either all or at least a good part of a 16-bit address, while with a separate I/O structure we need decode only a few.

Oh sure, there are some other apparent differences. For instance, the 6800 uses a separate R/$\overline{\text{W}}$ line and some timing lines, (VMA and Ø2), while the 8080 has separate $\overline{\text{I/OR}}$ and $\overline{\text{I/OW}}$ lines, but this really is dependent on the design philosophies of their manufacturers and has nothing to do with the I/O structure.

With some minor changes, the input port of Figs. 6 and 7 could be used with the 8080 or the Z-80, or a dozen other processors as well. Why don't you sit down and see if you can redraw Figs. 6 and 7 so they apply to the 8080 or Z-80?

Experiment #66
Interfacing an ASCII Keyboard

Problem: After the last experiment, do you really expect us to interface an entire keyboard? That looks like a pretty messy job. Didn't you drag us through enough in Experiment #65?

Solution: You are right, interfacing an entire keyboard can become quite tedious—especially if you don't have one. Let's look at one approach to the problem, and I'll leave it to you just how much you really want to try breadboarding on your console.

Theory: We talked about keyboards several months ago. At the time, I mentioned that there were two approaches you could take: (1) design an intelligent keyboard that did its own conversion to ASCII, checked for multiple keys being pressed, provided its own timing to eliminate false signals due to switch bounce or dirt and so on or (2) use a dumb keyboard approach in which there is the bare minimum of circuitry, and the processor has to do all the work by means of a program. Let's work on a keyboard design for an 8080 processor using the bare minimum of circuitry.

Fig. 10 shows about the least we can get away with. This design is very similar to what Radio Shack uses in their TRS-80, except that they use memory-mapped I/O with a Z-80.

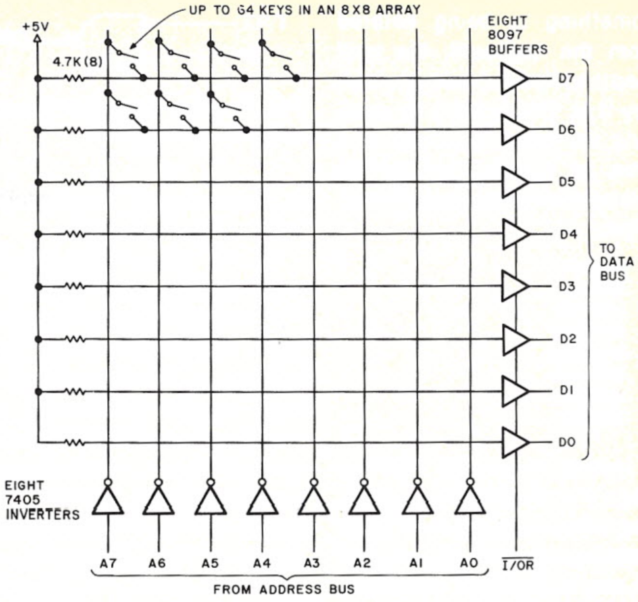

Fig. 10. Connecting a simple keyboard to an 8080.

Notice that here we have an 8 × 8 matrix of wires, much like that of an 8 × 8 ROM, except that keyswitches are used instead of memory cells at the intersections. (Only a few keyswitches are shown in Fig. 10, but there is room for up to 64.) At the bottom, we have the least significant eight bits of the address bus driving the vertical wires through 7405 inverters. (The 7405 is a "Hex Inverter with Open Collector Outputs." It is similar to the standard 7404 hex inverter, except that the part of the output circuit that makes the output go positive is missing. In this way the 7405 can pull an output lead to ground but cannot make it positive. An external resistor, called a pull-up resistor, is needed to do that. The 4.7k resistors are the pull-ups. In your experiment you can use 7404 inverters, or even 7400 gates with their inputs tied together.)

The horizontal matrix wires, which are the outputs, go through 8097 or 74367 Tri-state buffers to the data bus. These buffers are only enabled when the $\overline{\text{I/OR}}$ signal goes low as the result of the processor performing an IN instruction.

Now notice those eight pull-up resistors. Normally, the horizontal matrix output wires are held positive by those resistors, so that whenever the processor does an IN instruction it will get a 11111111 from the data bus as input.

But suppose that it does an input with a port address of hexadecimal FF, or binary 11111111. Now each of the 7405 inverters inverts the 1 input from the address bus into a 0, so that all eight vertical wires in the matrix are now grounded. If none of the keyswitches is closed, this has no effect on the output, and the processor still gets all ones.

However, if any of the keys on the keyboard is pressed, then one of the vertical input wires will be connected through a keyswitch to one of the horizontal output wires, and so one of the output bits will change to a 0. Thus, if the 8080 gets anything other than 11111111 as input, it knows that there is a key pressed somewhere on the keyboard. For instance, suppose that bit D4 is a 0; then the processor immediately knows that one of the eight keys connected to D4 has been closed.

The program should be written so that every now and then the 8080 does an IN instruction from port FF (or 11111111 in binary). If the number input from the keyboard is also FF or 11111111, then no key is being depressed. Thus we have here a quick way of checking the keyboard for activity under program control.

Once the 8080 discovers that

something is being entered from the keyboard, the next step is to find out exactly which key it is. This is done by scanning the input lines one at a time, by sending out the following addresses, one after another:

```
10000000
01000000
00100000
00010000
00001000
00000100
00000010
00000001
```

Notice how each address has a 1 in a particular position, and 0 elsewhere. Each of these addresses puts a ground level on one of the eight vertical input wires in the keyboard matrix. When that ground gets to the line that connects to the depressed key, the data bus will suddenly get a 0 on one of its lines. By examining which address line has a 1 and which data line has a 0, the 8080 processor can determine exactly which key is pressed. If more than one key is pressed, the processor can determine that, too.

Note that this only tells the processor which key has been pressed; if there is dirt on the contact then it might provide a key-pressed signal several times. It is up to the processor and its program to ignore short noise bursts such as might be created by switch bounce or dirt and to convert the key closure to the appropriate ASCII code, if needed.

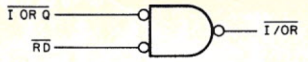

Fig. 11. Converting Z-80 I/O signals to 8080-type I/O.

By the way, the reason for using 7405 inverters instead of 7404 is simple. If two keys in the same horizontal column are pressed at the same time—a fairly common occurrence, especially with a fast typist—the outputs of two inverters are shorted together. With 7404 inverters, it might be possible for one to be trying to provide a 1 output as another is trying to provide a 0, with the result that they short each other out. Since a 7405 can only provide a 0 or an open—never a 1—two 7405 inverters can have their outputs connected together without that problem.

Although the Z-80 does not have an $\overline{I/OR}$ output, it could be used in this circuit as well. Fig. 11 shows how the $\overline{IORQ}$ and $\overline{RD}$ signals could be combined in a gate to provide an $\overline{I/OR}$. The gate, by the way, is a standard OR gate such as a 7432.

The strange AND symbol with circles on the inputs and outputs is used to signify that if the top input is 0 (low) and the bottom input is 0 (low), then the output is 0 (low). This sounds like an AND that is operating with 0 inputs and output; in fact, it is really just an OR, which provides a 0 output only if both inputs are 0. The strange symbol is used to tell an engineer that the function of the gate is to do an AND operation, not an OR.

Procedure: Since you have some inverters and 8097 buffers, you can wire up the circuit of Fig. 10. By simulating the address bus inputs as well as the keyswitches with jumpers, you can try it out as well.

A little more Theory: There is one problem with this circuit—it will go into operation whenever any IN instruction is performed. In other words, there cannot be any other input device used on the same system!

There are several ways to get around the problem. One, of course, is to connect all other input ports with memory-mapped logic, which avoids the problem altogether.

Another is to use address decoders on other input devices and connect their outputs so that whenever any other input device is selected, the keyboard is locked out.

Radio Shack's solution in the TRS-80 is to make the keyboard memory-mapped; instead of using $\overline{I/OR}$ for turning on the output buffers, the TRS-80 uses the output of an address decoder.

Another possible solution is to reduce the total number of keys from 64 (8 × 8 matrix) to 56 (7 × 8 matrix). This is reasonable, since most keyboards only need 53 to 56 keys anyway. By doing this, we can eliminate one of the vertical wires and free up an address bit. This address bit can then be ANDed with $\overline{I/OR}$, so that the output buffers are only turned on when that address bit is a 1 (or 0, depending on how it is wired). Whenever that bit is off, then the keyboard circuit is disabled, and up to 32 other input devices can be connected.

On a Z-80 there is still another way. During an IN and OUT instruction, when the least significant eight bits of the address bus carry the port address, the Z-80 outputs the contents of one of its internal registers on the other eight address bus bits. These are normally not used, but they could be decoded to enable the keyboard only under certain conditions.

Conclusion

We'll quit at this point but leave you with something to think about until next month—how would you connect, say, a seven-segment LED display to the processor? The solution next time.

Next time we will discuss special-purpose ICs that are designed to simplify input/output interfacing to a port; we'll also describe the function of interrupts. See you then! ■

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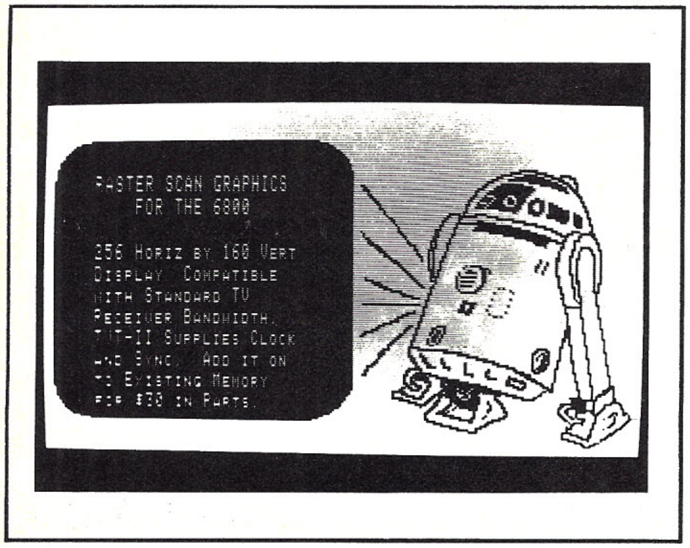
David Koh, M.D.
Dept. of Cardiology RG-20
University of Washington
Seattle WA 98195

Raster Scan Graphics for the 6800

(Part 2: The Software)

Last month we presented David Koh's incredible graphics mod for the TVT-II. Here's the software to make it go . . . along with some amazing photos showing what it can do.



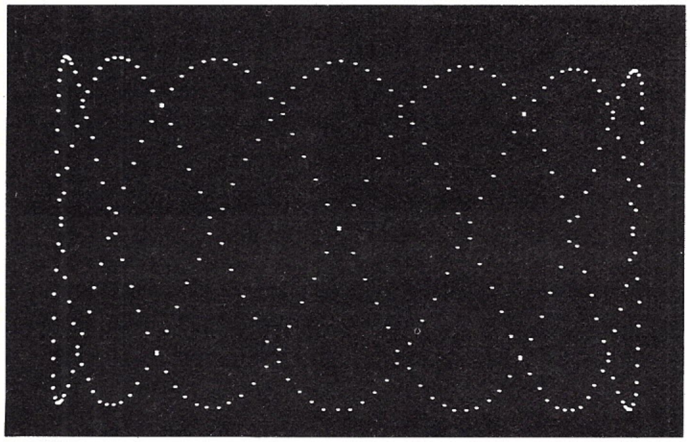


Photo 1. Digitally synthesized Lissajous figure. This is a static display produced by a simple BASIC program. This figure is a plot of horizontal and vertical sinusoidal input waveforms which are harmonically related in the ratio of 2 to 7.

Now comes the fun part—drawing pictures!

The graphics RAM is addressed and handled exactly like ordinary read/write memory. You can store and read data there and even store and execute programs. The only difference is that the contents of this memory are constantly displayed on the CRT as a bit pattern. This process is completely transparent to the MPU.

Every bit in this memory space of 6000 to 73FF has a unique location on the screen, which appears white if it is set to a logic 1, and black if it is cleared. See Fig. 1 for specifics on how this bit-mapping is done.

It would be nice to set or clear each bit without affecting any other bit; it would be nicer still to label each bit according to its horizontal and vertical location on the screen, rather than as the "5th bit in location 6AB3." The brute-force method of doing this is to sit down with pencil and graph paper and draw the desired picture by filling in squares. Next, block off each row into 8-bit groups, convert the binary representation to hex and load it into RAM via keyboard. This would not be much fun. It is far better to let a few software routines do this drudgery for you.

PLOT1 (Program A) is an assembly-language subroutine that will draw or erase a single dot each time it is called. The location of the dot is specified by its horizontal and vertical

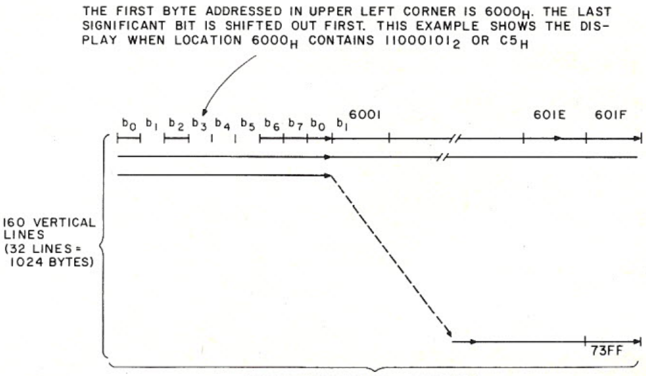


Fig. 1. Bit-mapping scheme.

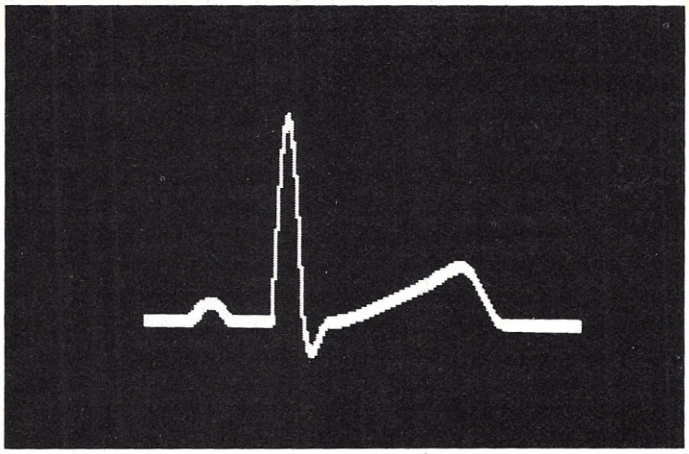


Photo 2. A simulated electrocardiogram. This ECG complex was produced by a BASIC program and slightly enhanced by manual use of an X-Y digitizer.

coordinates in hex referenced from the upper left corner of the screen. These two single-byte hex values must be stored in 00F0 and 00F1, respectively, before calling PLOT1. In addition, the value of location 00F2 (FLAG) determines whether the dot is erased or drawn. A zero stored here causes the dot to be erased; any nonzero value will draw a dot. FLAG is not altered and need not be redefined every time.

The starting address of the graphics memory is specified at locations 0105 and 0108. These should be changed if you configure your board to start elsewhere. Note that these values are the address before four left-shift operations. Location 012F is modified by the instruction at 012B in GETMSK, a subroutine that looks up a mask from a table. This approach may not be aesthetically pleasing, but it executes

Program A. PLOT1

```
                      NAM    PLOT1
               *******************************************
               *
               *  PLOT1-A BASIC PLOTTING
               *  SUBROUTINE FOR RASTER SCAN
               *  GRAPHICS.  PARAMETERS ARE
               *  PASSED THROUGH HORIZ, VERT,
               *  AND FLAG.  (0,0) IS THE
               *  UPPER LEFT CORNER.  IF FLAG
               *  IS ZERO THEN A DOT WILL BE
               *  ERASED.  IF FLAG IS SET THEN
               *  A DOT WILL BE DRAWN.
               *
               *        DAVID KOH
               *
               *******************************************
                      OPT    0,S
00F0                  ORG    $F0
00F0 0001      HORIZ  RMB    1
00F1 0001      VERT   RMB    1
00F2 FF        FLAG   FCB    $FF
00F3 0001      MASK   RMB    1
00F4 0002      TEMPAD RMB    2
00F6 0002      TINDEX RMB    2        TEMP. STORE FOR INDEX REG.
00F8                  ORG    $F8      LOOKUP TABLE FOR DOT MASK
00F8 01        TABLE  FCB    1,2,4,8,16,32,64,128
00F9 02
00FA 04
00FB 08
00FC 10
00FD 20
00FE 40
00FF 80
0100                  ORG    $100
     0100      PLOT   EQU    *
0100 36               PSH A           SAVE A,B,AND INDEX REG.
0101 37               PSH B
0102 DF F6            STX    TINDEX
0104 86 06            LDA A  #6       SETS BEGIN ADDRESS OF SCREEN
0106 97 F4            STA A  TEMPAD
0108 86 00            LDA A  #$00     SETS VERTICAL START OF WINDOW
              * BOTH GET SHIFTED 4 TIMES TO LEFT
010A 97 F5            STA A  TEMPAD+1
010C 96 F1            LDA A  VERT
010E D6 F4            LDA B  TEMPAD
0110 48        MULT   ASL A           MULT BY 2
0111 C9 00            ADC B  #0       ADDS CARRY IF ANY
0113 9B F5            ADD A  TEMPAD+1 ADD VERT LINE OFFSET
0115 48               ASL A           SHIFTS A&B 4 TIMES TO LEFT
0116 59               ROL B
0117 48               ASL A
0118 59               ROL B
0119 48               ASL A
011A 59               ROL B
011B 48               ASL A
011C 59               ROL B
011D D7 F4            STA B  TEMPAD   STORE THIS ADDRESS
011F 16               TAB             LOW BYTE TO B
0120 96 F0            LDA A  HORIZ
0122 8D 03            BSR    GETMSK
0124 7E 0140          JMP    BASE2
0127 84 07     GETMSK AND A  #%111
              * SPECIFIES WHICH BIT OF THE BYTE
              * REPRESENTS THE DOT
0129 8B F8            ADD A  #$F8
012B B7 012F          STA A  *+4
     0000      DIRECT EQU    0
012E 96 00            LDA A  DIRECT
0130 97 F3            STA A  MASK     STORE IT IN 'MASK'
0132 39               RTS
0133 96 F0     ADDRES LDA A  HORIZ    BUILDS LOW ORDER ADDRESS
0135 44               LSR A           DIVIDE BY 8
0136 44               LSR A
0137 44               LSR A
0138 1B               ABA             ADD IT TO LOW ORDER
0139 97 F5            STA A  TEMPAD+1 STORE IT
013B DE F4            LDX    TEMPAD   LOAD INDEX WITH IT
013D A6 00            LDA A  X        LOAD THAT BYTE
013F 39               RTS             RETURN
0140 7D 00F2   BASE2  TST    FLAG     IS FLAG=0?
0143 26 0E            BNE    WRITE    IF NOT, WRITE--ELSE ERASE
0145 43               COM A           INVERT MASK
0146 97 F3            STA A  MASK
0148 8D E9            BSR    ADDRES   GET THE BYTE
014A 94 F3            AND A  MASK     AND IT WITH INVERTED MASK
014C A7 00            STA A  X        STORE IT BACK
014E 33               PUL B           RESTORE REGISTERS
014F 32               PUL A
0150 DE F6            LDX    TINDEX
0152 39               RTS
0153 8D DE     WRITE  BSR    ADDRES
0155 9A F3            ORA A  MASK     OR IT TO ADD A DOT
0157 A7 00            STA A  X        STORE IT BACK
0159 33               PUL B           RESTORE REGISTERS
015A 32               PUL A
015B DE F6            LDX    TINDEX
015D 39               RTS
                      END
HORIZ  00F0
VERT   00F1
FLAG   00F2
MASK   00F3
TEMPAD 00F4
TINDEX 00F6
TABLE  00F8
PLOT   0100
MULT   0110
GETMSK 0127
DIRECT 0000
ADDRES 0133
BASE2  0140
WRITE  0153

TOTAL ERRORS 00000

S00B0000504C4F543120202024
S10400F2FF0A
S11E00F8010204081020408036 37DFF6860697F4860097F596F1D6F448C9001D
S11E01139BF548594859485948 59D7F41696F08D037E014084078BF8B7012F0E
S11E012E960097F33996F04444 441B97F5DEF4A600397D00F2260E4397F38DB2
S1180149E994F3A7003332DEF6398DDE9AF3A7003332DEF63903
S9030000FC
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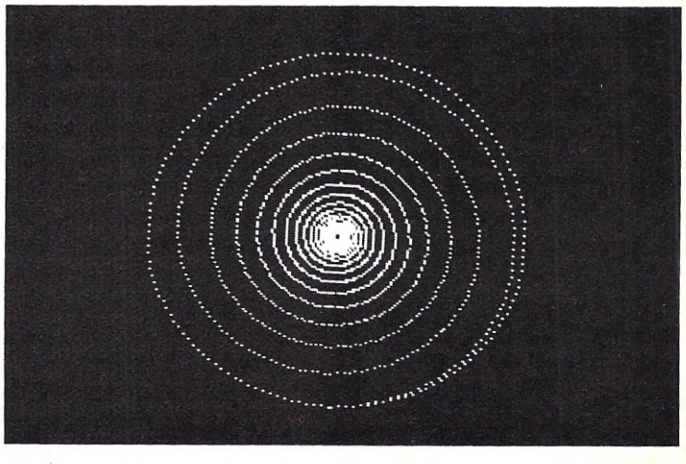

Photo 3. Spiral—another example of BASIC created graphics. Complex functions are easily displayed using BASIC, at the cost of slow execution.

rapidly and it works! Purists are welcome to rewrite the code and eliminate this trickery.

PLOT1 can be used several ways. For drawing pictures, hook up a digitizer to two parallel input ports and write a short driver that will transfer these bytes to 00F0 and 00F1 before calling PLOT1. Connect a pushbutton switch to a PIA control line to set or clear FLAG to control drawing or erasing. A joystick and A/D converter could be used as the digitizer. Any number of machine-language application programs could utilize PLOT1 for graphics output, including 3-D flight simulation, character generation, electrocardiogram display, etc.

A BASIC subroutine that performs the same function as PLOT1 is shown in Program B. It executes much more slowly than PLOT1, but is useful for displaying the results of complex calculations done in BASIC. It is written in SWTP 8K BASIC 2.0, which supports multiple statements per line. It should be a simple matter to tailor it to other BASIC interpreters. The subroutine itself consists of lines 0700 to 0790.

Lines 10 to 80 make up a simple calling program that will draw the Lissajous figure shown in Photo 1. This routine also requires three values before being called: H (for horizontal), V (for vertical) and Z (for flag). H and V are decimal integers from 0 to 255 and 0 to 159, respectively. Z is either zero to erase a dot or 1 to draw a dot. Lines 40 and 50 add an offset to H and V to set the origin at the center of the screen.

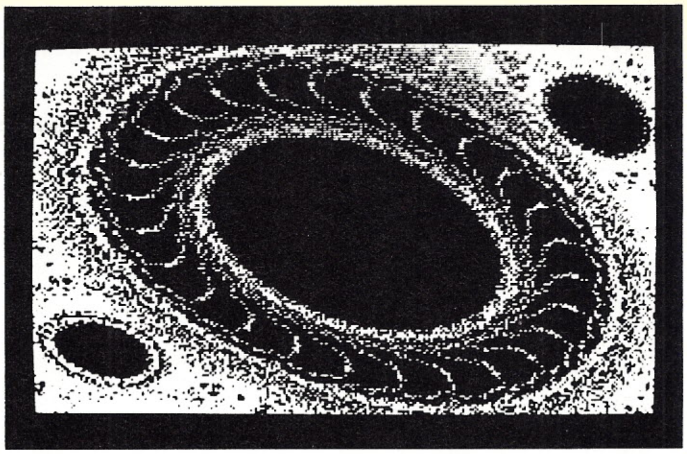

Photo 4. Galaxy 1. This and Photos 5 and 6 were generated by a modified assembly-language circle drawing algorithm. Each required from four to 20 seconds of MPU time to create.

```
0001 REM *RASTER SCAN GRAPHICS DEMONSTRATION PROGRAM
0002 REM *LINES 10 TO 80 PRODUCE A LISSAJOUS FIGURE.
0003 REM *LINES 700 TO 790 COMPRISE THE GRAPHICS
0004 REM *PLOTTING SUBROUTINE.
0005 REM *THE GRAPHICS RAM (6000H TO 73FFH) SHOULD BE
0006 REM *CLEARED PRIOR TO RUNNING THIS PROGRAM.
0007 REM *
0008 REM *
0009 REM *
0010  Z=1:I=0
0020  X=120*SIN(I)
0030  Y=75*COS(3.5*I)
0040  H=INT(X)+127
0050  V=INT(Y)+79
0060 GOSUB 700
0070  I=I+.0418879
0080 GOTO 20
0700 REM *PLOT SUBROUTINE IN BASIC.
0701 REM *REQUIRES 3 PARAMETERS:  H,V, AND Z
0702 REM *  H(ORIZ)=INTEGER FROM 0 TO 255
0703 REM *  V(ERT) =INTEGER FROM 0 TO 159
0704 REM *  Z:  SET TO 1 TO DRAW A DOT, 0 TO ERASE A DOT
0705 REM *(0,0) IS THE UPPER LEFT CORNER
0706 REM *EXAMPLE:  THE LINE  H=255:V=159:Z=1:GOSUB 700
0707 REM *  WILL DRAW A DOT AT THE LOWER RIGHT CORNER.
0708 REM *
0709 REM *
0710  H1=H/8:H2=INT(H1)
0715 REM *CALCULATE THE BIT POSITION
0720  H3=8*(H1-H2)
0725 REM *CALCULATE THE RAM ADDRESS
0730  M=24576 + 32*V+H2
0740  M1=PEEK(M)
0741 REM *UNPACK THE BYTE
0742  B7=0:IF M1>127 THEN B7=1:M1=M1-128
0743  B6=0:IF M1>63 THEN B6=1:M1=M1-64
0744  B5=0:IF M1>31 THEN B5=1:M1=M1-32
0745  B4=0:IF M1>15 THEN B4=1:M1=M1-16
0746  B3=0:IF M1>7 THEN B3=1:M1=M1-8
0747  B2=0:IF M1>3 THEN B2=1:M1=M1-4
0748  B1=0:IF M1>1 THEN B1=1:M1=M1-2
0749  B0=0:IF M1>0 THEN B0=1
0750 ON H3+1 GOTO 760,761,762,763,764,765,766,767
0755 REM *MODIFY THE BIT AND REBUILD THE BYTE
0760  B0=Z:GOTO 770
0761  B1=Z:GOTO 770
0762  B2=Z:GOTO 770
0763  B3=Z:GOTO 770
0764  B4=Z:GOTO 770
0765  B5=Z:GOTO 770
0766  B6=Z:GOTO 770
0767  B7=Z
0770  M1=0:IF B0=1 THEN M1=M1+1
0771 IF B1=1 THEN M1=M1+2
0772 IF B2=1 THEN M1=M1+4
0773 IF B3=1 THEN M1=M1+8
0774 IF B4=1 THEN M1=M1+16
0775 IF B5=1 THEN M1=M1+32
0776 IF B6=1 THEN M1=M1+64
0777 IF B7=1 THEN M1=M1+128
0780 REM *PUT IT NEATLY BACK
0785 POKE( M,M1)
0790 RETURN
```

Program B. Demonstration program in BASIC.

Note that the subroutine code could be shortened considerably by using subscripted variables and FOR-NEXT loops. I chose not to do this because of the substantial speed penalty imposed by the use of subscripts. A further small increase in speed can be obtained by defining a variable for each numerical constant using LET statements when the calling program is initialized. I felt that to do this, though, would render the listing undecipherable. Speed is not BASIC's forte, anyhow. BASIC's strengths lie in its ability to crunch numbers and its ease of programming.

Regardless of which program you use, you will want a routine to clear the screen. ERASER (Program C) is a simple assembly-language program that will do this in the blink of an eye. As shown here, it will clear the screen when you halt BASIC with the reset button and type G. Once the screen is cleared it will jump back to 0103, the soft-start address for BASIC. Do not load and execute this program until after BASIC has initialized from the hard-start address 0100 or you will bomb the interpreter.

The JMP instruction at A057 can be modified to vector back to your graphics operating system or whatever address you want. It can also be replaced by an RTS to convert the program into a subroutine.

Some Applications

The photos illustrate some of the things you can do with this graphics system.

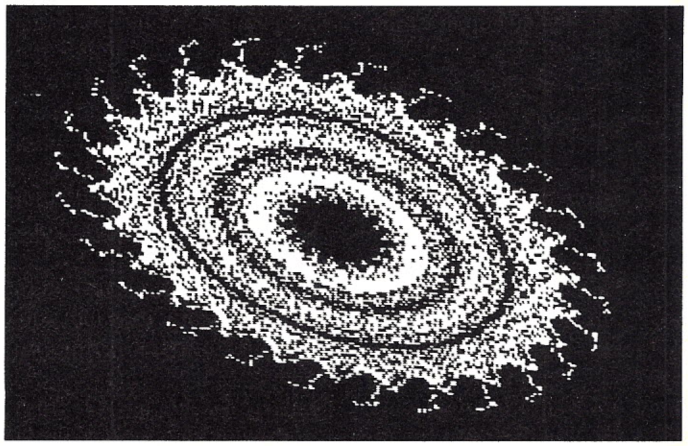

Photo 5. A close encounter?

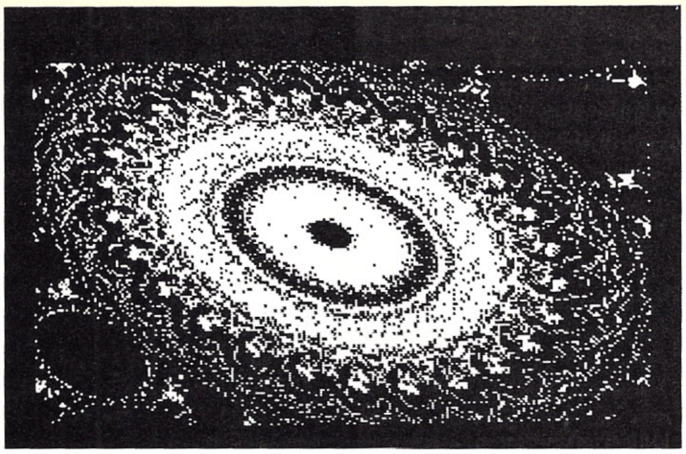

Photo 6. Galaxy 2. Note the illusion of gray scale made possible by varying the density of dots.

```
00001                       NAM    ERASER
00002                ****************************************
00003                * ERASER--CLEARS THE SCREEN AND JUMPS
00004                * BACK TO MONITOR, BASIC, OR USER ADDR.
00005                ****************************************
00006                       OPT    0,S
00007       6000     MEMBEG EQU    $6000
00008       73FF     MEMEND EQU    $73FF
00009       0103     RESTRT EQU    $0103
00010 A048                  ORG    $A048
00011 A048 A04A      PC     FDB    ERASER
00012 A04A 86 00     ERASER LDA A  #$0      CHANGE TO $FF TO FILL SCREEN
00013 A04C CE 6000          LDX    #MEMBEG
00014 A04F A7 00     LOOP   STA A  0,X
00015 A051 08               INX
00016 A052 8C 7400          CPX    #MEMEND+1  FINISHED?
00017 A055 26 F8            BNE    LOOP     IF NOT, LOOP BACK
00018 A057 7E 0103          JMP    RESTRT   IF SO, JUMP BACK TO BASIC
00019                       END
MEMBEG 6000
MEMEND 73FF
RESTRT 0103
PC     A048
ERASER A04A
LOOP   A04F
```

Program C. ERASER.

The lead photo shows my favorite recreational use for graphics: drawing cartoons. This one is of a little friend from long ago and far away. I used a flatbed X-Y digitizer made by Bolt, Baranek and Newman of Boston to draw him freehand. This unit was once offered as surplus by Delta Electronics, but I believe it is no longer in stock.

It is a marvelous collection of pulleys and cables that resolves two-dimensional motion into its linear X and Y components, which, in turn, move wiper contacts across etched encoder boards to produce X and Y values in 7-bit Gray code. These are parallel loaded into two sides of a PIA and converted to binary in software.

I used the unused eighth bit of each PIA side to signal that the cursor is active ("pen down") and to select draw or erase mode. Since the resolution of the digitizer is only 128 by 128, I wrote a small graphics operating system that positions the digitizing "window" anywhere on the screen. Its other commands are Clear Screen, Fill Screen and Save Picture to Tape.

This particular cartoon also illustrates how the graphics video and TVT-II output can be displayed simultaneously on the same monitor.

Photo 1 is the Lissajous figure produced by Program B. Although SWTP BASIC is not the fastest, it is extremely accurate. Note the smoothness of the curve and the absence of quantum gaps.

Photo 2 is a simulated electrocardiogram produced by a BASIC program. Though too slow for real-time display, this method allows lengthening and shortening various intervals in a convenient fashion for teaching or illustrative purposes. The use of raster scan technique allows the baseline to be nice and fat, something that cardiologists prefer (for some strange reason).

Photo 3 is a collapsing spiral drawn by BASIC. The program itself was trivial; however, the cost of programming ease is speed of execution. This picture took almost 30 minutes of processing time to draw.

By contrast, the galaxy and UFO-like pictures (Photos 4-6) took only four to 20 seconds to create. These were done using a modified assembly-language circle-drawing algorithm. The interesting patterns result from a combination of integer overflow and the display of eight different bits using 16-bit precision. Note that these pictures impart a definite impression of gray scale even though they are composed of on-or-off dots. This is due to the variable density of dots, not unlike the halftone process used in the printing industry.

Photo 7 shows a series of circles drawn by a slightly different algorithm using 8-bit precision. The center of each circle was shifted slightly before being drawn. This picture demonstrates what happens when a 64-character-per-line dot clock is used straight through without dividing it.

Each row of dots is displayed twice before the line counters are incremented. The result is

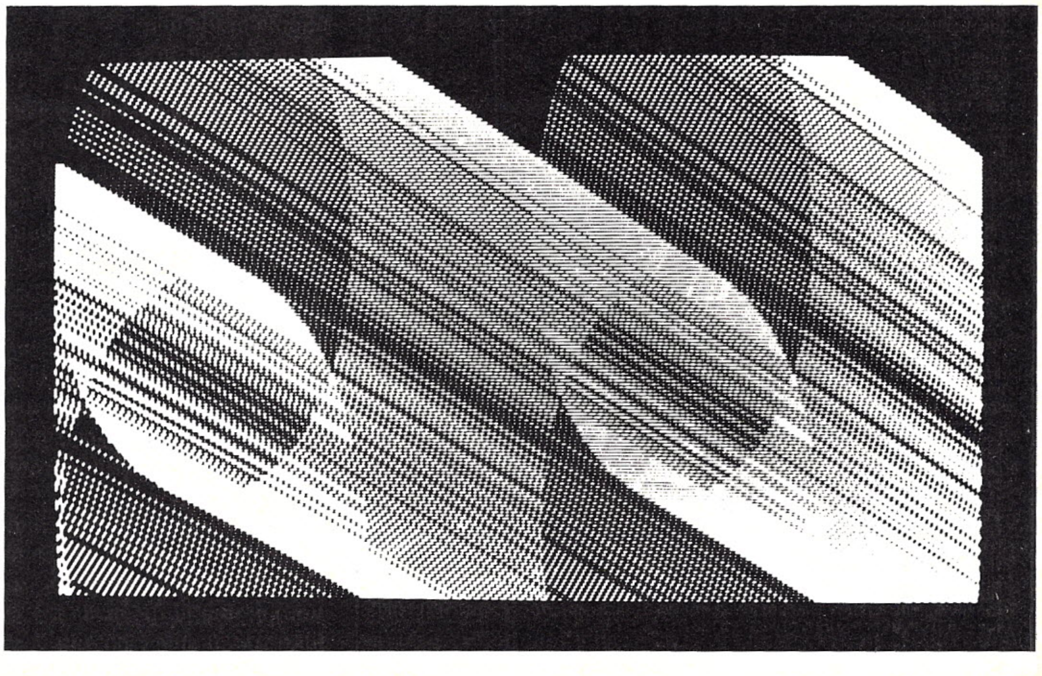

Photo 7. Sloping circles. This was generated by another modified circle generator and demonstrates a pseudo double-density mode described in the text.

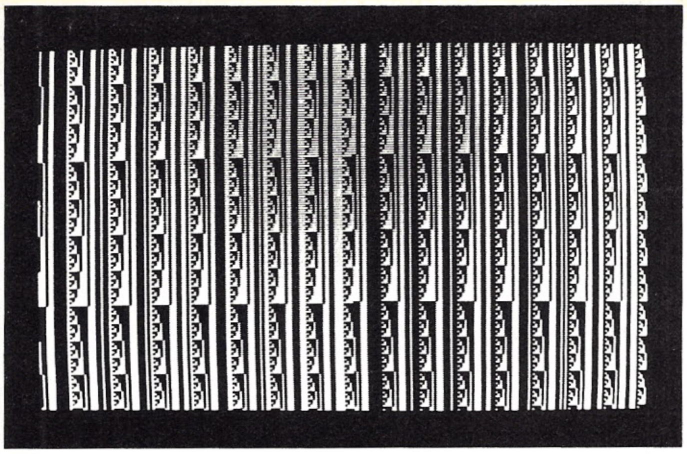

Photo 8. This is what a typical memory diagnostic looks like as it cycles through memory. This one stores ascending 16-bit binary patterns in sequential memory.

two identical pictures, side by side, giving 512-dot resolution horizontally and is the reason why the circles appear as ellipses.

Note that as the circle-drawer overflows, it wraps around and appears on the other side of the screen. Since the number of dots across is 256, exactly the capacity of 8-bit arithmetic, an interesting effect occurs. When two identical frames are concatenated, a line that wrapped around is in exact register with itself on the other side before it overflowed. Thus, lines appear to extend across the center where the two identical pictures meet.

The illusion of gray scale is even stronger in this picture because we are approaching the bandwidth limit of the monitor. Because of this, lone dots appear slightly dimmer than several dots in a row.

Photo 8 shows a 16-bit memory diagnostic as it cycles through the graphics RAM. This points out a novel use for this system—namely, monitoring the activity of your MPU in a very revealing fashion.

Placing the stack here allows you to see just how deeply your program nests subroutines. If you put in one more PUSH instruction than there are PULLs, the stack will grow before your eyes to engulf the errant program. Placing this block of memory at the end of contiguous memory allows you to watch your text buffer fill and warns you when to dump some of it to tape or the printer.

Conclusion

I hope you enjoy building and using this graphics system. I'd like to hear from any of you who build it, and find out what applications you've dreamed up for it. Please enclose an SASE if you request a reply.

As I mentioned before, there is much room for further development. Color, gray scale and higher density all warrant investigation. I hope this article will prompt others to come up with related peripherals: digitizers, scanning densitometers, hard-copy output, light pens, slow scan converters, etc. . . . and, of course, the software to go with them.

Before closing I'd like to thank Angus Mathson for his fine help in photo preparation.■

References

1. M6800 Microcomputer System Design Data, Motorola 1976.
2. Thomas Buschbach, "Add This Graphics Display to Your System," *Byte,* November 1976.
3. W. F. Galway and D. J. Anderson, "Serendipitous Circles," *Byte,* August 1977.
4. D. Hudson, "6800 Circle Maker," *Dr. Dobb's Journal,* June/July 1977.

SWTP 4K RAM Write Protect Option

Good things come in small packages . . . a trite statement, but this article is worth reading.

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Fairborn OH 45324

At times it is desirable or even mandatory to simulate ROM program or data stores; or, when debugging a new program, write protection can prevent a program from being inadvertently scrambled. A write protect feature can easily be added to the SWTPC 6800 4K RAM board. The schematic in Fig. 1 shows the new configuration.

The PC runners from pins 7 and 9 of IC19 are cut on the top of the board. The switch is then mounted on the corner of the board, which is diagonal to IC19. There is sufficient space in this corner to drill a hole for the switch to mount perpendicular to the board. Connecting wires may be routed on the top of the board.

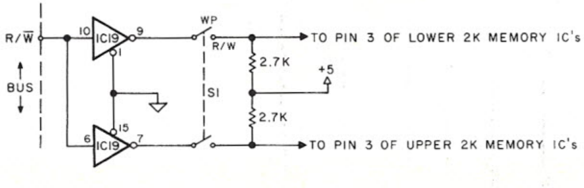

Fig. 1.

When the switch is in the R/W position, the memory functions normally. When the switch is in the WP (write protect) position, the R/W bus signal is removed from the memory ICs and replaced by a continuous READ logic level (always high).

This modification will write protect the entire 4K of memory. To write protect only a 2K segment, use an SPST switch and only connect the desired gate's output.■

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Technical Systems Consultants' Text Editor

Ron thought a lot of TSC's Text Editor; he even used it to prepare this article.

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Ann Arbor MI 48105

Several months ago I purchased Technical Systems Consultants' Text Editor. I bought only the manual and source listing, which contains a hex dump, and spent a couple of evenings entering and debugging it. The editor, along with TSC's companion Text Processor, is being used to prepare this review.

The editor is so full of features that there are usually several ways to accomplish a given edit function. I find several of the features rather endearing, after working with Motorola's editor in their Exorciser system. This editor supplies line numbers automatically and has a RENumber command. You can "turn off" the printing (or CRT display) of numbers, though they are still assigned, by entering the command NUmbers. This command "toggles" the state of the numbers on and off. The editor initializes in the numbers on mode.

There is also a Verify mode in which any line that has been edited will be listed on the terminal after the changes have been made. This can be turned off, but unless you are a genius who never makes a mistake, you'll want to have it on.

Like most editors, TSC's has an "invisible" pointer that points at the "current line." The print command "P" will always print the current line on the terminal. A carriage return will do the same thing. All edit functions default to operating on the current line, but may be extended to be effective over a selected number of lines, or to be truly global in effect, i.e., to operate on the whole file.

Commands may be chained. Special symbols may be user defined. Tabs may be set up, and the text will automatically expand as marked by the tab character—also user defined.

There are two modes, or states of operation, of the editor—the Command mode and the Insert mode. In the Command mode, the program prompts with a #. If you type SET TAB = ':' the colon is defined as the "tab" indicator in your text. Tab stops are set by the command TAB 5,9, 17, etc. The numbers refer to the column number, like the TAB function in BASIC. By typing SET EOL = '$' you have defined the $ as the command separator for a chain of commands.

The manipulation of the edit pointer is crucial in a text editor because the pointer is "invisible." In this editor there are several ways to move the pointer . . . and to specify the "range" of a command. Typing "5P6" will print to the terminal 6 lines starting at line #5. "5P#9" will print line 5 through line 9.

/Motorola/ P will print the next line below the current line that has the word "Motorola." You can go back in the file, too. Type -/Motorola/ P to print out the line preceding the current one and containing the word Motorola. The current line pointer always moves when text is printed to the terminal so that it points at the last line printed out.

Some additional pointer movers include ↑P, which moves the pointer to the top of the file and prints the first line, and !P (! is a down arrow on some terminals), which will print the last line of the file. ↑P! will print the whole file. T will move the pointer to the top of the file and not cause printout.

B similarly moves the pointer to the bottom of the file. It is unfortunate for multisystem users like myself that Motorola uses B for the "beginning" of the file and Z for the end. Somehow, T and B are logical, as would be A and Z, but B and Z make no sense at all. It is too bad that there aren't some standards for text editors.

Some of the commands are illustrated below. The simulated printout is what will print if the "verify" mode is on.

```
1. CHANGE COMMAND

37.00=THIS IS A TEST
#C/THIS/THAT/
37.00=THAT IS A TEST

37.00=THAT IS A TEST
#C/THAT// (CHANGE THAT TO NULL)
37.00= IS A TEST

#C//THIS/ (CHANGE NULL TO THIS)
37.00=THIS IS A TEST

2. APPEND
#A/./
37.00=THIS IS A TEST.

3. FIND

#T$F/TEST/
37.00=THIS IS A TEST.
```

The / is a delimiter. Any symbol can be used, but the symbol should not appear in the string.

```
4. OVERLAY

37.00=THIS IS A TEST
OVERLA   P        X
37.00=THIP IS A TEXT

5. GLOBAL CHANGES
#T$C/#7/#9/ ! *
```

This means go to the top and change the string #7 to #9 to the bottom (!) of the file, and do it for all occurrences (*). This command will change every #7 to #9 in the whole file.

6. HEADER COMMAND (see Example 1). The command causes the column numbers to be printed. The – indicates that there is a tab set for that column.

7. DELETE. 27D10 deletes ten lines starting from line 27. If you give up, there's always ↑D!, which will delete the whole file.

8. NEXT.N causes the pointer to move to the next line and print it.

9. INSERT. I causes the editor to enter the insert modes and insert text after the current line. Lines are renumbered if necessary.

10. MOVE AND COPY. MO #7 5. This will move five lines starting with the current line, to be inserted after line #7. The original lines are deleted. Copy does the same thing, but leaves the original lines as they were.

```
HEADER 01234567-890123456-7890123456789012345678901234567890123456789012345678
```

Example 1.

TSC has both cassette and disk versions (disk for SWTP's new FLEX operating system—see "The Latest in Operating Systems for the 6800: FLEX" by Mickey Ferguson, *Kilobaud*, October 1978, p. 72). The cassette version will allow you to save all or any part of a file to tape. Line numbers are

not saved on tape or disk, and files are renumbered when loaded. The disk version will allow you to create and edit a file too large to fit in your memory. Using two disks, one with the file and the other with the editor, you can edit a file approximately 64K characters long!

The disk version never deletes a file. The old file is renamed with the suffix .BAK for backup, and the new file retains the suffix of the original file. For this reason, two nearly blank disks are required to edit a large file. I have successfully edited a file that prints out 32 standard 8½ by 11 pages of double-spaced text. The editor could handle almost twice this.

Is it perfect? Not quite. I would like to see the following: ↑/PH./D!*.

Suppose you have a name and address file with phone numbers, and you want to print a bunch of address labels. It certainly would be nice to be able to edit the file (creating a new temporary one) in such a way as to delete all the phone numbers.

My proposed command would go to the top of the file and find and delete all the lines containing the string /PH./ all the way to the bottom of the file. This is precisely how the change command would work, but it would only delete the string /PH/ and leave the rest of the line. As the editor stands, you could use the command line: ↑F/PH./ ! *, which would list all the lines of interest if the verify mode were on, and you could then delete the lines by line number.

If you were to try the command: ↑D/PH./ ! *, you would only delete all lines from the top of the file to the first line containing the string /PH./. This slight inconsistency in the use of line specifiers and range targets is the largest problem in learning to use the editor effectively. It is well worth the effort, however.

If you have a disk system, this editor will edit your BASIC files as well as text. It is delightful not to have to type in a whole line again to correct the omission of a parenthesis on the end of the line. This editor can also be used to create source files for TSC's assembler. The assembler is not much different from Motorola's or SWTP's (which it replaces in the disk system). It will, however, produce a sorted symbol table, and the source listing allows you to modify such things as the print routine to optimize operation with a nonstandard printer.

The combination of the editor and the TSC Text Processor is as good as a "professional" text-processing system—at 1/3 of the price, including computer with 32K memory, printer, dual disk drive and CRT terminal! All TSC progams come with complete, well-commented source listings. These are an education in themselves and, along with the discussion in the manual of modifications and "personalization" for individual sytems with different terminals, printers, etc., make the programs much more valuable. In my opinion, this editor is well worth having and learning. TSC's software is all reasonably priced.■

Technical Systems Consultants
Box 2574
W. Lafayette IN 47906

SL68-24	6800	Text Editing System	$23.50
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SL68-24p		With Paper Tape	31.50
SL80-10	8080	Text Editing System	28.50
SL80-10p		With Paper Tape	37.50

David B. Moody
1515 Saunders Crescent
Ann Arbor MI 48103

Spelling Bee

Too often, watching and listening to the tube contribute to illiteracy. Put this program on your terminal and cassette recorder during prime time and help reverse the trend.

Spelling Bee is an educational game with a twist. Instead of responding to messages displayed on the terminal, the user responds to spoken words by typing their correct spelling. Before you dismiss this program as requiring speech synthesizers and other exotic hardware you don't have, read on a bit. The spoken words come from the ubiquitous audio cassette recorder. (In the event you had forgotten, "audio" means you can also use devices for things other than data.) The only real hardware requirement is programmable motor control for your recorder or a port you can use to operate a relay or transistor switch. (I use an opto-isolated switching system described by Wayne D. Smith in the November 1977 *Byte*, pp. 114-127.)

During the quiz portion of the program, the recorder motor is turned on long enough to allow a recorded spoken word to pass over the playhead. The tape will then stop, and the program will ask, "How do you spell that word?"

The user has three chances to get the word correct. If he/she misses on the first try, feedback is given as to whether the number of letters in the guess was correct—too many or too few. If the number of letters in the second guess is correct, but the word is still misspelled, the user is told which letters were guessed correctly. After the third miss, the program gives the correct spelling.

A score is kept for each word, and at the end of each quiz, words are grouped according to the number of misses and output to the terminal so that the most frequently misspelled words can be used again.

An obvious question concerns how the computer keeps track of where it is on the tape. The answer is that the computer only keeps track of time while the quiz is going on. The secret is that the program also provides a facility to record the tape. Thus, the same timing loops are used both when the tape is recorded and when it is played back so that things stay synchronized.

The recorder motor is turned on for 4 seconds during which time the operator speaks a word into the recorder microphone. The program then asks for the correct spelling of the word, which it stores away in the array W$ for the later quiz. The record-type cycle repeats until the word "stop" is typed. Then the operator is taken step-by-step through setting up the tape for the quiz. Thus, during the recording process, the program "learns" the spelling of the words that will be presented.

The Program

Let's look at some features of the program, which was written in TDL 12K BASIC. Any BASIC that allows string manipulation (MID$, LEN) and output to the motor-control port should work. In this version, the recorder is controlled by bit 1 of port 78H in OUT statements scattered throughout the program. (The ampersand prefix to numbers in TDL BASIC indicates they are to be interpreted in hexadecimal.) The I/O port (implemented with an MC6820 PIA) is initialized at line 1800; this statement will have to be modified for your particular configuration.

The last line in the program is the subroutine that handles all the time delays. The calculation of EXP (LOG(100)) is simply included to waste time. If your BASIC doesn't have EXP or LOG, you'll have to find some other way to waste time. The value (100/12) found in this statement is the critical factor which determines that each unit of the variable "T" will result in a one-second delay. That this value is not an integer produces a slight error in timing but not enough to worry about.

It was determined by first substituting 100 in place of the factor T*(100/12), then executing the statements GOSUB 8900:END and noting the time required to complete the subroutine. In my system, this subroutine took 12 seconds to do the 100 computations. By dividing the 100 by 12 seconds, we obtain the number of calculations that are done in 1 second; multiply this by T, the number of seconds' delay required, to produce a program-controlled timing loop.

Lines 1900-3200 provide optional step-by-step instructions for setting up the system to record tapes. These were designed to be fairly detailed and somewhat interactive. The two black plugs referred to in line 2300 are the data input and output plugs from the computer to the cassette. Removing these will connect the microphone for recording and the speaker for playback on most recorders.

A third plug, which is red on my system, must be left connected to provide motor control. The red switch mentioned in line 2500 is the automatic motor-control override switch that allows computer control in the up position.

During the instruction phase, carriage returns must occasionally be issued to inform the program that you have performed the required steps. For example, a return is requested in line 2600 to signal the program that the recorder has been set up as required. Then in line 2700, the tape motor is enabled for 10 sec to move the tape past any leader on the cassette.

The "right-hand light" mentioned in line 2800 is an LED located on the recorder control box, which is used to signal the

operator that the recorder is ready to receive a word. It is strictly optional and is referred to only in OUT statements in lines 3500 and 5100.

The words are entered in lines 3400 to 3900. In line 3500, the recorder is enabled for 1 sec, and then the "right-hand light" is turned on by bit 80H. The recorder remains on for 3 sec, during which time the word is spoken into the recorder microphone. Line 3700 controls the 3 sec delay and then turns off the recorder and light.

When the word "stop" is entered, control is transferred to the next step-by-step instruction phase. If "stop" is a word you would like to test, then change lines 3900 and 7300, plus instruction line 3100 to whatever word (or symbol) you would like to use to tell the program to stop.

The rewind sequence requires you to enter several carriage returns, but takes care of such details as turning on the motor so you can rewind the tape. For playback, the ten-second tape operation required to move past the leader is handled in line 4600. Note that this, and every other tape motion operation, must be exactly matched in the record and playback portions of the program in order to keep the tape synchronized with the program.

Line 4700 advances the paper on the Teletype so that it may be torn off, hiding the typed-in words. If you are using this program with a video terminal, substitute a statement here to clear the screen.

In lines 5000-7300, the quiz is carried out. The recorder is first run for 4 sec, playing a recorded word, then the user inputs his spelling of the word as variable G$. Correct responses are dealt with in lines 6800-7300. Errors are handled in lines 5700-6700. (The unnumbered lines following 5400, 5800, 6500 and 6800 are continuations of the previous lines.)

As mentioned earlier, various hints are given after errors. The type of hint is controlled by the variable NT, the number of tries, which varies from 1 to 4. If NT is equal to 1, lines 5800-6000

```
1000 REM >>>>>SPELLING TEST PROGRAM<<<<<
1100 REM
1200 REM      BY: DAVID B. MOODY
1300 REM           1515 SAUNDERS CRESCENT
1400 REM           ANN ARBOR, MICHIGAN 48103
1500 REM
1600 CLEAR 200:DIM W$(40),WC(40)
1700 REM >>>> SET UP OUTPUT PORT
1800 OUT &79,0:OUT &78,&FF:OUT &79,&4:OUT &78,0:PRINT
1900 INPUT "DO YOU WANT INSTRUCTIONS";A$:IF LEFT$(A$,1)="Y" THEN 2300
2000 INPUT "HIT RETURN AS SOON AS YOU ARE READY";A$
2100 OUT &78,1:T=10:GOSUB 8900:OUT &78,0:GOTO 3400
2200 REM >>>> GIVE STEP-BY-STEP INSTRUCTIONS
2300 PRINT "FIRST, DISCONNECT THE TWO BLACK PLUGS FROM THE RECORDER."
2400 PRINT "THEN PLACE A BLANK TAPE IN THE RECORDER, AND SET TO"
2500 PRINT "RECORD.  ALSO, PLACE THE RED SWITCH ON THE LIGHT BOX
2600 INPUT "IN THE UP POSITION.  WHEN YOU ARE READY, HIT RETURN";A$
2700 OUT &78,1:T=10:GOSUB 8900:OUT &78,0
2800 PRINT "WHEN THE RIGHT-HAND LIGHT COMES ON, READ A WORD INTO"
2900 PRINT "THE MICROPHONE.  WHEN THE LIGHT GOES OFF, THE COMPUTER
3000 PRINT "WILL ASK YOU TO TYPE IN THE WORD.  THIS PROCESS WILL
3100 PRINT "CONTINUE UNTIL YOU TYPE THE WORD 'STOP'.
3200 PRINT:INPUT "HIT RETURN WHEN YOU ARE READY TO START";A$:PRINT
3300 REM >>>> START INPUTTING WORDS HERE
3400 FOR C=1 TO 40
3500 T=1:GOSUB 8900:OUT &78,1:T=1:GOSUB 8900:OUT &78,&81
3600 REM >>>> WORD IS RECORDED DURING THE NEXT STATEMENT
3700 T=3:GOSUB 8900:OUT &78,0
3800 INPUT "WORD";W$(C)
3900 IF W$(C)<>"STOP" THEN NEXT C
4000 REM >>>> END OF INPUT - DO STEP-BY-STEP REWIND SEQUENCE
4100 PRINT "STOP THE RECORDER";:GOSUB 4400:OUT &78,1
4200 PRINT "REWIND THE TAPE TO THE BEGINNING";:GOSUB 4400:OUT &78,0
4300 PRINT "SET THE RECORDER TO PLAY";:GOSUB 4400:GOTO 4500
4400 INPUT ", THEN HIT RETURN";A$:RETURN
4500 FOR N=1 TO 40:WC(N)=0:NEXT N
4600 OUT &78,1:T=10:GOSUB 8900:OUT &78,0
4700 FOR N=1 TO 10:PRINT:NEXT N
4800 REM >>>> READY TO START THE QUIZ
4900 INPUT "HIT RETURN TO START";A$
5000 FOR C=1 TO 40:NT=0
5100 T=1:GOSUB 8900:OUT &78,1:T=1:GOSUB 8900:OUT &78,&81
5200 REM >>>> RECORDER OUTPUTS WORD DURING NEXT STATEMENT
5300 T=3:GOSUB 8900:OUT &78,0
5400 PRINT:INPUT "HOW DO YOU SPELL THAT WORD";G$
5500 NT=NT+1
5600 IF W$(C)=G$ THEN 6900
5700 IF NT=3 THEN PRINT "STILL NOT RIGHT - THE WORD IS SPELLED- ";
      W$(C):WC(C)=NT:GOTO 7300
5800 IF NT=2 GOTO 6200 ELSE IF LEN(W$(C))=LEN(G$) THEN
      PRINT "YOU HAVE THE CORRECT NUMBER OF LETTERS, BUT";:
      PRINT " NOT THE RIGHT SPELLING. ":GOTO 6100
5900 IF LEN(W$(C))>LEN(G$) THEN PRINT "NOT ENOUGH LETTERS. ";:GOTO 6100
6000 IF LEN(W$(C))<LEN(G$) THEN PRINT "TOO MANY LETTERS. ";
6100 INPUT "TRY AGAIN";G$:GOTO 5500
6200 IF LEN(W$(C))<>LEN(G$) THEN 5900
6300 PRINT "THE FOLLOWING LETTERS ARE CORRECT: ";
6400 FOR N=1 TO LEN(G$)
6500 IF MID$(W$(C),N,1)=MID$(G$,N,1) THEN PRINT MID$(G$,N,1);
      ELSE PRINT "-";
6600 NEXT N
6700 PRINT:GOTO 6100
6800 REM >>>> GOT IT RIGHT!
6900 WC(C)=NT-1:ON NT GOTO 7000,7100,7200
7000 PRINT "THAT'S IT - FIRST TRY!!!":GOTO 7300
7100 PRINT "GOT IT ON THE SECOND TRY.":GOTO 7300
7200 PRINT "TOOK YOU THREE TRIES TO GET IT.":GOTO 7300
7300 IF W$(C+1)="STOP" THEN 7500 ELSE NEXT C
7400 REM >>>> END OF LIST FOUND- OUTPUT SCORE
7500 PRINT "THAT'S ALL THE WORDS I HAVE FOR NOW.":PRINT:PRINT
7600 V=0:FOR N=1 TO 40:V=V+WC(N):NEXT N:IF V<>0 THEN 7800
7700 PRINT "A PERFECT TEST!!!!!!!  GOOD GOING.":END
7800 FOR M=3 TO 1 STEP -1:V=0:FOR N=1 TO 40
7900 IF WC(N)=M THEN V=V+1
8000 NEXT N:IF V=0 THEN 8700
8100 PRINT:ON M GOSUB 8400,8500,8600
8200 FOR N=1 TO 40: IF WC(N)=M THEN PRINT W$(N)
8300 NEXT N:GOTO 8700
8400 PRINT "THE FOLLOWING WORDS ONLY TOOK 2 TRIES:":RETURN
8500 PRINT "YOU GOT THE FOLLOWING WORDS ON YOUR LAST TRY:":RETURN
8600 PRINT "YOU NEVER GOT THE FOLLOWING WORDS - STUDY THESE HARD:"
      :RETURN
8700 NEXT M:END
8800 REM >>>> SUBROUTINE TO PROVIDE DELAYS
8900 FOR Z9=1 TO T*(100/12):V=EXP(LOG(100)):NEXT Z9:RETURN

READY:
```

Program listing.

```
DO YOU WANT INSTRUCTIONS? YES
FIRST, DISCONNECT THE TWO BLACK PLUGS FROM THE RECORDER.
THEN PLACE A BLANK TAPE IN THE RECORDER, AND SET TO
RECORD.  ALSO, PLACE THE RED SWITCH ON THE LIGHT BOX
IN THE UP POSITION.  WHEN YOU ARE READY, HIT RETURN?
WHEN THE RIGHT-HAND LIGHT COMES ON, READ A WORD INTO
THE MICROPHONE.  WHEN THE LIGHT GOES OFF, THE COMPUTER
WILL ASK YOU TO TYPE IN THE WORD.  THIS PROCESS WILL
CONTINUE UNTIL YOU TYPE THE WORD 'STOP'.

HIT RETURN WHEN YOU ARE READY TO START?

WORD? FOSSIL
WORD? CRYSTAL
WORD? PERSUADE
WORD? RUBBISH
WORD? FAHRENHEIT
WORD? STORIES
WORD? STOP
STOP THE RECORDER, THEN HIT RETURN?
REWIND THE TAPE TO THE BEGINNING, THEN HIT RETURN?
SET THE RECORDER TO PLAY, THEN HIT RETURN?

HIT RETURN TO START?

HOW DO YOU SPELL THAT WORD? FOSSEL
YOU HAVE THE CORRECT NUMBER OF LETTERS, BUT NOT THE RIGHT SPELLING.
TRY AGAIN? FOSSLE
THE FOLLOWING LETTERS ARE CORRECT: FOSS--
TRY AGAIN? FOSSOL\LO\IL
TOOK YOU THREE TRIES TO GET IT.

HOW DO YOU SPELL THAT WORD? CRYSTIL
YOU HAVE THE CORRECT NUMBER OF LETTERS, BUT NOT THE RIGHT SPELLING.
TRY AGAIN? CRYSTEL
THE FOLLOWING LETTERS ARE CORRECT: CRYST-L
TRY AGAIN? CRYSTAL
TOOK YOU THREE TRIES TO GET IT.

HOW DO YOU SPELL THAT WORD? PERSWADE
YOU HAVE THE CORRECT NUMBER OF LETTERS, BUT NOT THE RIGHT SPELLING.
TRY AGAIN? PERSWEDE
THE FOLLOWING LETTERS ARE CORRECT: PERS--DE
TRY AGAIN? PERSUADE
TOOK YOU THREE TRIES TO GET IT.

HOW DO YOU SPELL THAT WORD? RUBISH
NOT ENOUGH LETTERS. TRY AGAIN? RUBBISH
GOT IT ON THE SECOND TRY.

HOW DO YOU SPELL THAT WORD? FERENHEIT
NOT ENOUGH LETTERS. TRY AGAIN? FERRENHEIT
THE FOLLOWING LETTERS ARE CORRECT: F--RENHEIT
TRY AGAIN? FAIRENHEIT
STILL NOT RIGHT - THE WORD IS SPELLED- FAHRENHEIT

HOW DO YOU SPELL THAT WORD? STORIES
THAT'S IT - FIRST TRY!!!



YOU NEVER GOT THE FOLLOWING WORDS - STUDY THESE HARD:
FAHRENHEIT

YOU GOT THE FOLLOWING WORDS ON YOUR LAST TRY:
FOSSIL
CRYSTAL
PERSUADE

THE FOLLOWING WORDS ONLY TOOK 2 TRIES:
RUBBISH
```

Sample Run.

give information on the length of the word. If NT = 2 and the length is correct, lines 6300-6600 print the correct letters, filling in the incorrect ones with a "-". When NT = 3 and the word is missed, line 5700 provides the correct spelling.

Whenever a word is guessed, or after three tries, the variable WC(N), which corresponds to W$(N), is set equal to one minus the number of guesses required. For example, WC = 0 if the word is spelled correctly on the first try, and WC = 3 if the word is not guessed by the third try. In line 7300, the next word stored in the array W$ is checked to see if it is "STOP." If so, control is transferred to line 7500, which tells the user that the test is over.

The values in the array WC are then used in lines 7600-8700 to summarize the results of the quiz. First, this part of the program checks for no errors by deciding if all WC(N)s are zero. If there are errors, it then determines if any words were never spelled correctly, and if there were any, it prints them. It then does the same for words guessed on the third try; then for words guessed on the second try. Words spelled correctly on the first try are not printed at the end.

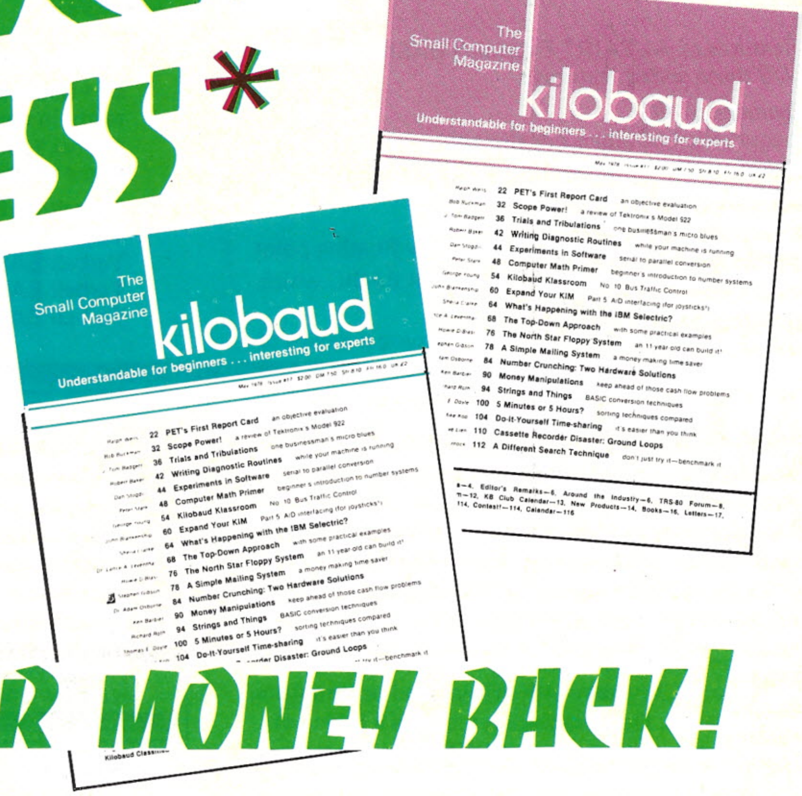
With TDL 12K BASIC, this program requires a full 16K of memory. If you are fortunate enough to have more memory, change line 1600 to CLEAR 400, thereby increasing string space and allowing longer words.

That's the program as our family uses it. Several interesting variations are possible. For example, it might be used to test foreign-language vocabularies by having the tape recorder pronounce a word and the user respond with a simple definition.

The ultimate version could use a stereo recorder with one channel for audio I/O and the other channel to provide exact digital data and synchronization. If the second channel were recorded to contain, in digital form, the word presented on the audio channel, then the tapes could be reused without the recording-typing stage required in the present program.

Before you run off to buy a stereo recorder, however, bear in mind that most BASICs are not fast enough to support direct data I/O from cassettes. Therefore, this idea will probably require some special tricks such as the one by Gene Embry mentioned in the February 1978 *Kilobaud* ("The BASIC Forum," p. 7). An added sophistication would be the use of the Meca Alpha-1 tape system, which provides high-speed digital search, plus an audio channel. ■

MICROCOMPUTER MADNESS*



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CP/M 1.4 Update Package

A TARBELL Update Package for those now using CP/M 1.3 is now available on diskette. The Update Package adds new commands and the ability to access four disk drives, as well as 2 new CP/M manuals, TARBELL CP/M User's Guide and a new BIOS listing. Price: $50.00.

SPOOLER

This 8080 program will save many hours of computing time. It intercepts all output to the list device, spools the output to a high-speed disk file, and directs the spooled data to a low-speed printer during unused cycle time while the CPU waits for transfer of data to and from the console. System throughput is greatly increased with the aid of SPOOLER. Output is never lost due to insufficient memory allocation. Fully compatible with the CP/M file system, SPOOLER permits parallel processing without hardware interrupt, and with minimal impact on other processes. Price: $70.00 (Copyright KLH Systems.)

BASIC-E Compiler

Designed to work with CP/M Disk Operating System this software requires a total of 20K bytes of memory. Included are 26 compiler error messages and 23 run-time error messages. Disk files may be read, written or updated by using both sequential and random access. Included are blocked and unblocked files. Price for compiler and run-time monitor on diskette is $10.00. Manual is available separately for $5.00. (Public domain software by Gordon E. Eubanks, Jr.).

CBASIC Programming System

Upward compatible from BASIC-E, CBASIC is similar but expanded to include several business oriented facilities, allowing decimal computations to 14 digits of precision, data formatting and PRINT USING statements. Statements allow access to disk files and disk file maintenance. Strings of characters may be read from the console to permit correct input line format to be checked before reading data. General programming features include variable names up to 31 characters, optional line numbers, dynamic debugging tracers, and optional data output to printer. CBASIC on diskette and manual priced at $100. (Copyright Software Systems.)

EMPL-an 8080 APL

Especially suited to educational applications, EMPL is an adaptation of APL, using the ASCII character set. Only one-dimension arrays are allowed. This 8K version occupies the first 5376 bytes of memory and operates in two modes. The Execution Mode permits all instructions to be executed immediately. The Definition Mode permits the user to enter functions. EMPL on Tarbell Cassette with manual is $15. (Copyright 1977 Erik Mueller).

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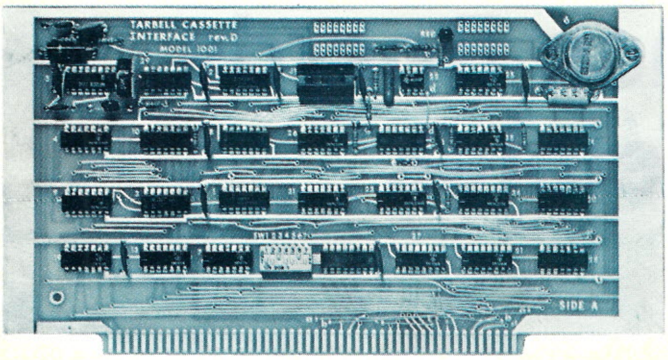

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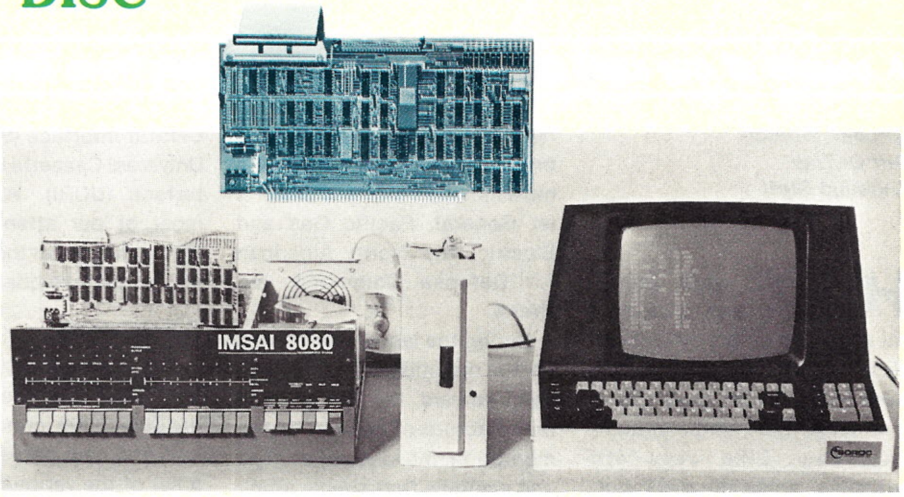

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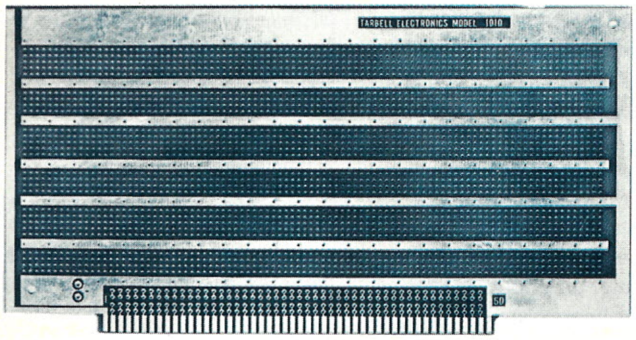

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Two Interface Boards from Teletek

A couple of our staff took a look at two boards from Teletek. Here's their assessment.

Mitchell Wolrich
Jeff DeTray
Kilobaud *Staff*

"Here today, gone tomorrow." It's easy to be cynical and more than a little suspicious when the discussion turns to firms that have recently entered the microcomputer business. Like July 4th sparklers, some microcomputer companies have been known to burn brightly for a short while, then fizzle out, never to be seen again. That's one reason it is encouraging to see companies such as Teletek Enterprises enter the fray.

Unlike some microcomputer companies, Teletek has been around a while, although they are new to the hobby market. For ten years, they've been serving the needs of industrial, military and governmental customers. The company's first products of interest to hobbyists are a pair of versatile S-100 interface boards described below.

Teletek, while not well known to hobbyists, has a solid reputation among the technological heavyweights. They built this reputation in the specialized field of instrumentation calibration. Teletek's customers have included the likes of Aerojet General, Pacific Gas and Electric, the North American Air Defense Command and NASA.

During the last three years or so, the direction of the firm has been toward the design and manufacture of custom instrumentation, the kinds of devices and systems that simply aren't available off the shelf. One project has involved producing custom-made stray voltage testers to fly on each of NASA's Space Shuttles.

The point of all this is to show you that Teletek is not some "fly-by-night" outfit. This is a well-established company that is putting the full force of its considerable technical expertise behind its line of microcomputer products. The two interface boards are designed to offer combinations of functions that aren't available on other single boards. Teletek is betting that customers will appreciate saving an S-100 slot or two. As you'll see, such a saving is quite possible.

At the present time, Teletek offers two products of interest to the hobbyist: the System Central Interface (SCI) and the Universal Cassette Recorder Interface (UCRI). We'll devote most of our attention to the SCI, as it is by far the more complex of the two boards.

The Hardware

The Teletek SCI combines the functions of three or more individual S-100 interface boards into one neat package. Here is a list of the various features of the board, along with some commentary.

- Three independent parallel ports, each bit programmable for input or latched output. Handshake signals also available. Implemented via two 6821 PIAs.
- One serial port with RS-232, 20 mA or 60 mA current loop interfaces. User selectable speeds between 45 and 9600 baud via software control. Implemented via a 6850.
- One high-speed biphase (Tarbell compatible) cassette interface. User selectable speeds from 800 to 100,000 baud via software control. Can also be used as a programmable signal generator. Implemented using an 8253 programmable timer.
- Two on-board relays for control of two tape recorders. If you use separate READ/WRITE decks these signals come in handy. The monitor provided with the SCI can handle this type of configuration.
- Three status lines, programmable for either input or output. Useful for controlling functions such as rewind, head-load, etc., on Phi-decks, etc.
- Power on reset. Very nice whether you have a front panel or not (and especially nice if you don't). Hardware forces execution to begin at the first EPROM position. The standard SCI software runs at D000 (hex), so to start execution at, say, D01E, the first 3 bytes would look like this: D000 C3 1E D0. Note: If you want to jump out of the first 1K block, you must use an indirect jump. An example would be if you wanted to boot a North Star disk system; the software would look like this:

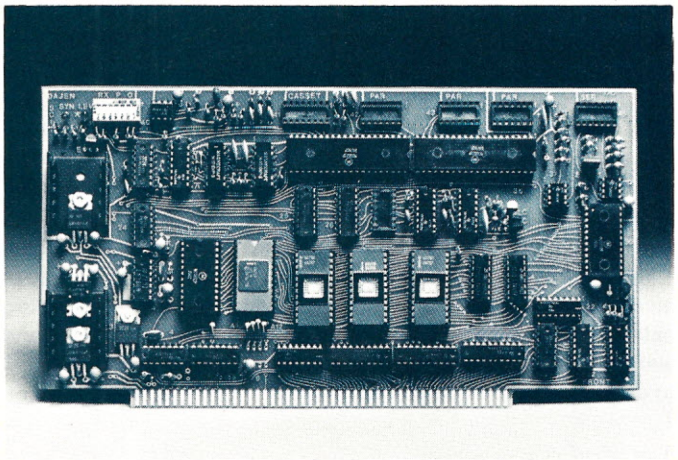
```
D000 C3 03 D0
D003 C3 00 E9
```

This design eliminates false reset of the reset-jump circuit when the SCI is addressed at F000.

- 2708 EPROM programmer. This sure helps when you are developing custom software or making changes in the monitor. Eliminates the need for a

separate EPROM programmer. Note: The socket can also be used as another 1K of software routines when you aren't programming 2708s.

- 256 bytes of on-board RAM. Useful as stack and buffer space; won't eat any memory from user work space.
- Two 2708 sockets. Contains 2K of monitor routines. See description under software.



System Central Interface (SCI).

Note: David Jenkins of Teletek informs us that they will be offering a version that will accept 2716s. This will give the user 4K of monitor routines, plus a 2716 programmer! Additional note: The SCI can utilize 650 ns 2708s. That will save you a few dollars.

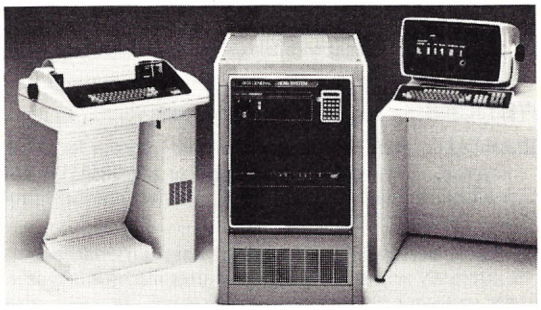
The Software

The following is a summary of commands available in the SCI Monitor Version 1.6.

- Assign input device—from either serial, parallel or keyboard port.
- Assign output device—from either serial, parallel or video board.
- Dump hex—standard hex dump, 16 bytes/line.
- Dump ASCII—dumps eight hex bytes, followed by the ASCII equivalents.
- Enter—enters hex data into memory.
- Go—starts program execution at given address.
- Input from port—prints hex value of specified port number.
- Output to port—outputs specified byte to specified port number.
- Program 2708—programs a 2708 according to Intel specifications, also verifies data in EPROM against RAM and prints any differences (errors).
- Read cassette—loads data from tape into memory.
- Read verify—compares data on tape to data in RAM.
- Search—will locate a hex string up to nine bytes long in memory and print the address of all occurrences of it. Useful in hand-relocating programs!
- Set read speed for cassette—between 800 and 100,000 baud.
- Set serial port speed—between 45 and 9600 baud.
- Set write speed for cassette—between 800 and 100,000 baud.
- Verify a block of memory—against another block; prints any differences noted.
- Write cassette—writes a block of memory to cassette tape.
- Zero memory—fills memory with a hex constant between two addresses. If no constant is specified, zero is assumed.

User Report

Dave Jenkins, designer of the SCI, has done an outstanding job in all aspects of the project. The board is very well laid out and works quite well. The SCI is one of the most versatile interfaces that we've seen to date due to its "totally programmable approach." Software defines everything in the system,



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KIT A: $57.50 4 Unregulated Voltages Available +8.5V/25A, −8.5V/3A, ±17V/3A

Includes **TRANSFORMER T2** [25A, size 3/¾" (l) x 4⅛" (w) x 3⅛" (h)], **CAPACITOR C1** (100,000 UF, 15V), **BRIDGE RECTIFIERS: D1** (30A, 50V) & **D2** (4A, 50V), **FUSE HOLDER, BARRIER STRIP, ALUMINUM PLATE** [13"(l) x 5" (w) x 3/16" (t)], **3X CAPACITORS** (6,000 UF, 45 V), **4X RESISTORS and All Necessary Mounting Parts.**

KIT B: $47.50 4 Unregulated Voltages Available +8.5V/15A, −8.5V/2A, ±17V/2A

All Parts are same as in KIT A, EXCEPT: **CAPACITOR C1** (52,000 UF, 15V) and **TRANSFORMER T1** [15A, Size 3⅜" (l) x 4" (w) x 2 13/16" (h)].

You May Buy Transformers Alone:
T2 (25A) & **T1** (15A) at **$22.50 and $17.50 respectively.**

SHIPPING CHARGES: $4.75 per TRANSFORMER
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(213) 530-3732

Store
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Paramount, CA 90723
Mon.-Sat.: 9 am–6 pm

from the dynamically programmable baud rates to the very method of modulating the tape interface. The interface will handle Tarbell, Kansas City, CUTS and possibly other cassette formats merely by your changing the software.

As an example of how flexible the interface is, we'll describe the methods of assigning the system console. To start the system up, you can tell it to use a video board and the on-board keyboard port or use the on-board serial port. This is accomplished by a DIP switch. After the system is up, you can change baud rate of any of the serial devices or change the system console itself, all with one command.

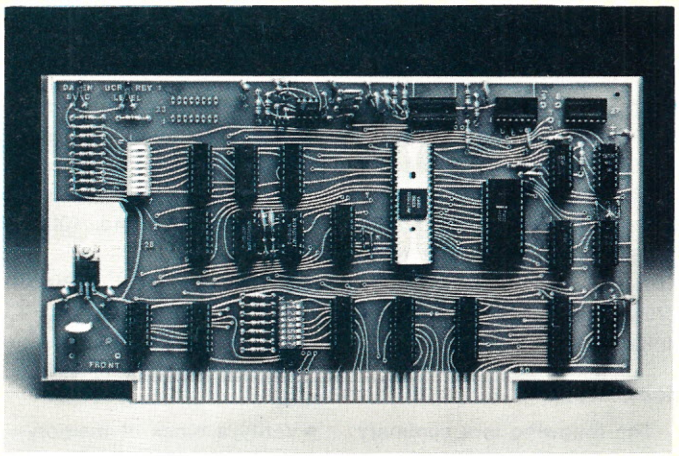
Input/output is handled very nicely by a series of system calls. To interface your software to the board, all you have to do is look up the proper system call and call it. No need to worry about details such as port numbers, status bits and other trivia; let the system handle it.

The documentation provided is good and accurate. The manual could use a bit more organization and highlighting in certain areas, such as system start-up—it isn't very clear just how to tell it what you're using for a console device, until you turn to page 11 (which follows the instructions: "after the interface is up . . ."). The manual includes pin-outs and port definitions for all of the various devices, in case you want to roll your own software.

All in all, the SCI is a good buy for anyone with an S-100 bus computer.

UCRI

The UCRI board consists of the cassette interface portion and keyboard port of the SCI. The UCRI can read and write data from 518 to 41,666 baud. The baud rate is set by means of a DIP switch on the board, whereas the SCI handles this with software. The UCRI will have many applications in systems where a high-speed biphase cassette interface is required, but where a system monitor and other interfaces are not necessary. Like the SCI, the UCRI can utilize a variety of cassette formats, including Tarbell, Kansas City, CUTS and others. On-board relays are included for cassette control.



Universal Cassette Recorder Interface (UCRI).

The UCRI board would be ideal for an already working system that lacks a cassette interface.

The Future

What's in store from Teletek? Well, in a few months, they plan to bring a floppy-disk controller onto the market, a package designer David Jenkins promises will be "very interesting." After that, there is talk of a highly sophisticated 16-bit micro. Of course, Teletek will continue its work for industry and the government. After ten years, they know when they have a good thing going. ■

The C3-S1

by Ohio Scientific

Possibly the world's most popular floppy disk based microcomputer.

Since its introduction in August, 1977, the Challenger III has gained tremendous acceptance in small business, educational and industrial development applications. Thousands of C3-S1's have been delivered and today hundreds of C3-S1 demonstrator units are set up at computer retailers around the country.

Why has the Challenger III become so successful in the fiercely competitive microcomputer industry? Here are just a few of the possible reasons.

- The Challenger III is the fastest microcomputer in BASIC (see "BASIC Timing Comparisons," *Kilobaud,* October, 1977, where Ohio Scientific out benchmarks all competitors).
- The Challenger III is the only computer system with a 6502A, 6800 and Z-80 offering the programmer all popular micros for maximum versatility.
- The C3 is backed by the largest base of systems level software for any microcomputer system including:
  - For the 6502A:
    - Microsoft 6 and 9 Digit BASIC
    - Assembler Editor
    - Word Processor
    - OS-65D Development DOS
    - OS-65U End User DOS with Extended BASIC
      - For Floppys
      - Winchester Hard Disks
      - Multi-users (Level 2)
      - Distributed Processing (Level 3)
  - For the 6800:
    - Floppy DOS
    - Assembler Editor
  - For the Z-80:
    - Floppy DOS
    - Microsoft Disk Extended BASIC
    - Microsoft FORTRAN
    - Microsoft COBOL
    - Macro Assembler and Editor
    - And Much More
- The C3 supports OS-65U, the ultra high performance "virtual data memory" DOS for floppys and hard disks which makes complex file structures like multi-key ISAM easy to use.
- The C3 is backed by a large library of applications programs and can make use of the tremendous amount of BASIC programs offered by independent suppliers and publishers because it uses Microsoft BASIC, the standard of the industry. Complete turnkey and custom business packages are available for the C3 from most OHIO SCIENTIFIC DEALERS.
- The C3 electronics and software are available in alternate mechanical configurations for special applications including the C3-OEM for volume users and the C3 letter series (C3-A, C3-B) which are optimized for use with hard disks.
- C3 systems are always delivered ready to use with 32K static RAM, dual floppys for 500K bytes of on-line storage and an RS-232 port strappable from 75 to 19,200 baud all *standard* in the minimum configuration.
- C3 systems offer the greatest expansion capability in the microcomputer industry. The C3 series supports OHIO SCIENTIFIC'S full line of over 40 expansion accessories. The maximum configuration is 768K bytes RAM, four 74 million byte Winchester hard disks (CD-74), 16 communications ports, real time clock, line printer, Word Processing printer and numerous control interfaces.
- C3 systems have phenomenal performance-to-cost ratios. The C3-S1 base price with 32K RAM, dual floppys, RS-232 port complete with 8K BASIC and DOS is under $3600 and expansion accessories are comparably priced. For example, the CD-74, 74 million byte Winchester disk complete with interface and OS-65U operating system at about $6000.

The C3 series is quite possibly so successful because it offers the highest hardware performance, best software support, most versatility and greatest expandability in the microcomputer systems market at nearly the lowest price in the industry.

For more information, contact your local OHIO SCIENTIFIC DEALER or the factory at (216) 562-3101.

OHIO SCIENTIFIC

1333 S. Chillicothe Road • Aurora, Ohio 44202

Attention, Chess Buffs!

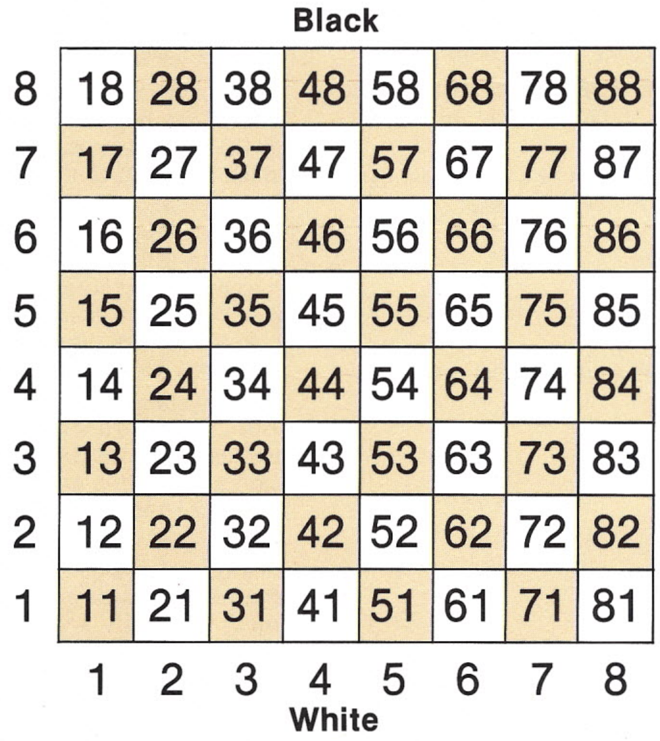
Korchnoi and Karpov worried about opponent strategies being smuggled into their matches. Lucky for each of them that his opponent didn't have this article up his sleeve.

Tom Orr
249 Juanita Way
Placentia CA 92670

Every serious chess player has a repertoire of chess openings and defenses ready to play. The player usually builds up his repertoire by consulting the many books on chess openings and selecting the ones that suit his style of play.

My method of reviewing openings was to cover the listing of an opening with a piece of paper, which I slid down to reveal only one move at a time. While following the opening on my chessboard, I would make each move, attempting to guess the proper book move.

However, there was a disadvantage to this method. When my guess was incorrect, I would find the correct move as soon as I slid the paper down. What I needed was a method to determine an incorrect guess without displaying the correct move. This would make me analyze the chessboard position more closely and also reinforce the correct move when I determined it.



Black

8	18	28	38	48	58	68	78	88
7	17	27	37	47	57	67	77	87
6	16	26	36	46	56	66	76	86
5	15	25	35	45	55	65	75	85
4	14	24	34	44	54	64	74	84
3	13	23	33	43	53	63	73	83
2	12	22	32	42	52	62	72	82
1	11	21	31	41	51	61	71	81
	1	2	3	4	5	6	7	8

White

Fig. 1. International correspondence chess notation.

The ideal way to learn is from a chess instructor making the opponent's move and telling you when your move is incorrect. Lacking a 24-hour-a-day chess instructor, I decided to make my Radio Shack TRS-80 computer my chess-opening instructor.

The Program

The program is written in Radio Shack's Level I BASIC but should be adaptable to other BASICs. By changing statements 20 and 40, the computer will play either the white or black pieces, allowing the operator to play both positions of openings he is likely to use.

When an error is made, the computer prints "WRONG, TRY AGAIN" and gives the operator another chance. If, after five tries, the operator still has not guessed correctly, the computer responds with the correct move. The program keeps record of the number of errors and rewards flawless performance with "VERY GOOD."

I used international correspondence chess notation for

```
READY
>LIST
4  REM CLEAR SCREEN
5  CLS
10  PRINT"CHESS OPENING PROGRAM"
15  REM ENTER IF PLAYER IS WHITE OR BLACK
20  PRINT "YOU ARE BLACK"
30  REM IF COMPUTER IS WHITE LET P = 1
40  P = 1
50  E = 0:G = 0:N = 0
51  W = 0:B = 0
60  READ W,B
70  IF W = 7777 THEN 420
80  IF B = 7777 THEN 420
90  IF W = 8888 THEN 440
100  IF B = 8888 THEN 440
110  IF W = 9999 THEN 460
120  IF B = 9999 THEN 460
130  N = N + 1
140  PRINT N;".";
150  IF P = 1 THEN 290
160  INPUT M
170  IF M<>W THEN 220
180  G = 0
190  PRINT TAB(20);"CORRECT"
200  PRINT "    ";B
210  GOTO 60
220  E = E + 1
230  G = G + 1
240  IF G = 5 THEN 270
250  PRINT TAB(20);"WRONG, TRY AGAIN"
260  GOTO 160
270  PRINT"THE CORRECT MOVE IS ";W
275  G = 0
280  GOTO 200
290  PRINT W
300  INPUT "    ";M
310  IF M<>B THEN 350
320  PRINT TAB(20);"CORRECT"
330  G = 0
340  GOTO 60
350  E = E + 1
360  G = G + 1
370  IF G = 5 THEN 400
380  PRINT TAB(20);"WRONG, TRY AGAIN"
390  GOTO 300
400  PRINT"THE CORRECT MOVE IS";B
405  G = 0
410  GOTO 60
420  PRINT "WHITE IS BETTER"
430  GOTO 470
440  PRINT "EQUAL GAME"
450  GOTO 470
460  PRINT "BLACK IS BETTER"
470  PRINT "YOU MADE ";E;"ERRORS"
480  IF E = 0 THEN 540
485  PRINT
490  PRINT "NAJDORF SICILIAN—FROM MCO PAGE 150 COL 8"
495  PRINT
500  PRINT "TYPE RUN TO GO AGAIN OR"
510  PRINT "TYPE CLOAD TO LOAD THE NEXT OPENING"
515  PRINT
520  PRINT "THANK YOU AND GOOD LUCK IN CHESS"
530  END
540  PRINT "VERY GOOD"
550  GOTO 485
600  DATA 5254,3735,7163,4746,4244,3544,6344,7866,2133,1716
601  DATA 3175,5756,6264,4826,4142,2622,4423,2847,7566,7766
602  DATA 6152,8785,5171,2213,1141,6857,7181,4735,5263,1817
603  DATA 2335,1335,8888,8888
```

Program listing.

the moves (see Fig. 1). The reasons are as follows.

1. Ambiguous moves are eliminated. There is no conflict between moves such as R/1-B5 and KR-B5, as can happen with English descriptive chess notation. If the moves in the program were written in descriptive notation, the operator would have to enter them exactly as written or the computer would classify them as errors.

2. Simple BASIC language programs, such as that used in the TRS-80, cannot compare strings.

This form of notation is widely used in international correspondence chess where a language barrier concerning the names and positions of the pieces might occur. If your computer can compare strings and you prefer descriptive or algebraic notation, you can easily convert the program.

At the end of each program, the computer prints out the chess opening's name and the chess book reference from where it was taken (this helps in case more investigation is necessary). If the reference book

indicates that white or black has an advantage, or the game is equal at the end of the opening, I enter 7777, 8888 or 9999 for the last two moves. The program translates these numbers to "WHITE IS BETTER," "EQUAL GAME" or "BLACK IS BETTER," respectively.

Once the program is entered, it is necessary only to change the DATA statements (600 and above) to enter the moves and program statements 20 and 40 to determine whether the computer plays the white or black pieces. I then record the opening on cassette tape. I generally alternate my favorite white and black openings on a cassette. This forces me to do a little more thinking and reinforces the principles of the opening in my mind.

When I am playing the black pieces, I like to use the Najdorf version of the Sicilian Defense against white's 1. P-K4 (see sample program). The moves for this opening are entered at the DATA statements starting at 600. In my reference book this version is classified as an equal game for both players, hence the 8888 as the last two moves.

So, get out your chess-opening books, translate the openings you like into international correspondence notation and let your computer be your chess-opening instructor. ■

```
CHESS OPENING PROGRAM
YOU ARE BLACK
1 . 5254
  ?3735
                      CORRECT
2 . 7163
  ?4746
                      CORRECT
3 . 4244
  ?3544
                      CORRECT
4 . 6344
  ?7866
                      CORRECT
5 . 2133
  ?1716
                      CORRECT
6 . 3175
  ?5756
                      CORRECT
7 . 6264
  ?4826
                      CORRECT
8 . 4142
  ?2622
                      CORRECT
9 . 4423
  ?2847
                      CORRECT
10 . 7566
  ?4766
                      WRONG, TRY AGAIN
  ?7766
                      CORRECT
11 . 6152
  ?8785
                      CORRECT
12 . 5171
  ?2213
                      CORRECT
13 . 1141
  ?6857
                      CORRECT
14 . 7181
  ?4735
                      CORRECT
15 . 5263
  ?1817
                      CORRECT
16 . 2335
  ?1335
                      CORRECT
EQUAL GAME
YOU MADE 1 ERRORS

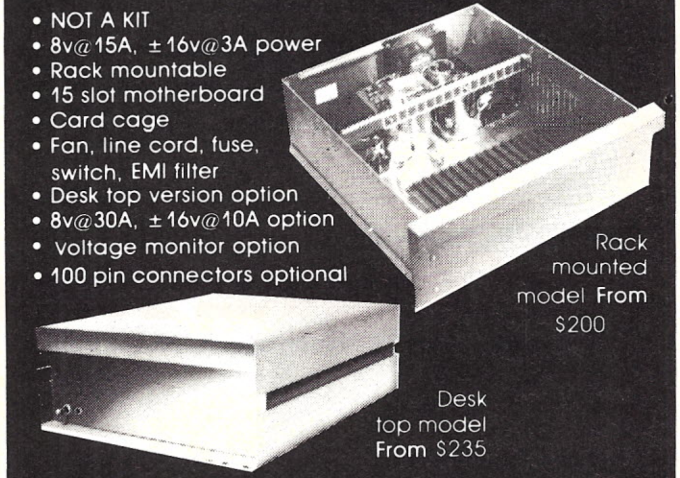
NAJDORF SICILIAN—FROM MCO PAGE 150 COL 8

TYPE RUN TO GO AGAIN OR
TYPE CLOAD FOR THE NEXT OPENING

THANK YOU AND GOOD LUCK IN CHESS

READY
>-
```

Sample program run.



Specifications:
S-100 compatible. MFM encoding, 35 tracks with ten 512-byte sectors per track. 179,200 bytes on double density SA-400 and North Star BASIC, DOS, and Monitor included.

For further information, write for full color catalog or contact your local computer store.

New from North Star

Double Density Performance at Single Density Prices

The new HORIZON computer and Micro Disk System now record in double density! That means each new Shugart SA-400 minifloppy disk drive accesses 180K bytes of on-line information. All double density HORIZON computers and Micro Disk Systems have a redesigned controller which allows the use of quadruple capacity disk drives as they become available in early 1979. A three-drive North Star System with quadruple capacity disk drives will access over a megabyte of on-line information. But, best of all there's no price increase for double density models.

North Star BASIC and DOS have been upgraded to accommodate the increased capacity and yet run existing programs with little or no change. The new disk system also supports single density, so existing single density diskettes can still be used. Single density SA-400 drives previously purchased with North Star systems can also be used.

Pricing

HORIZON with one double density SA-400 minifloppy (180K bytes), 16K RAM, Z80A processor and serial I/O port: $1599 kit, $1899 assembled.

MICRO DISK SYSTEM with one double density SA-400 minifloppy, controller board and power regulation: $699 kit, $799 assembled. (Cabinet and power supply $39 extra each.)

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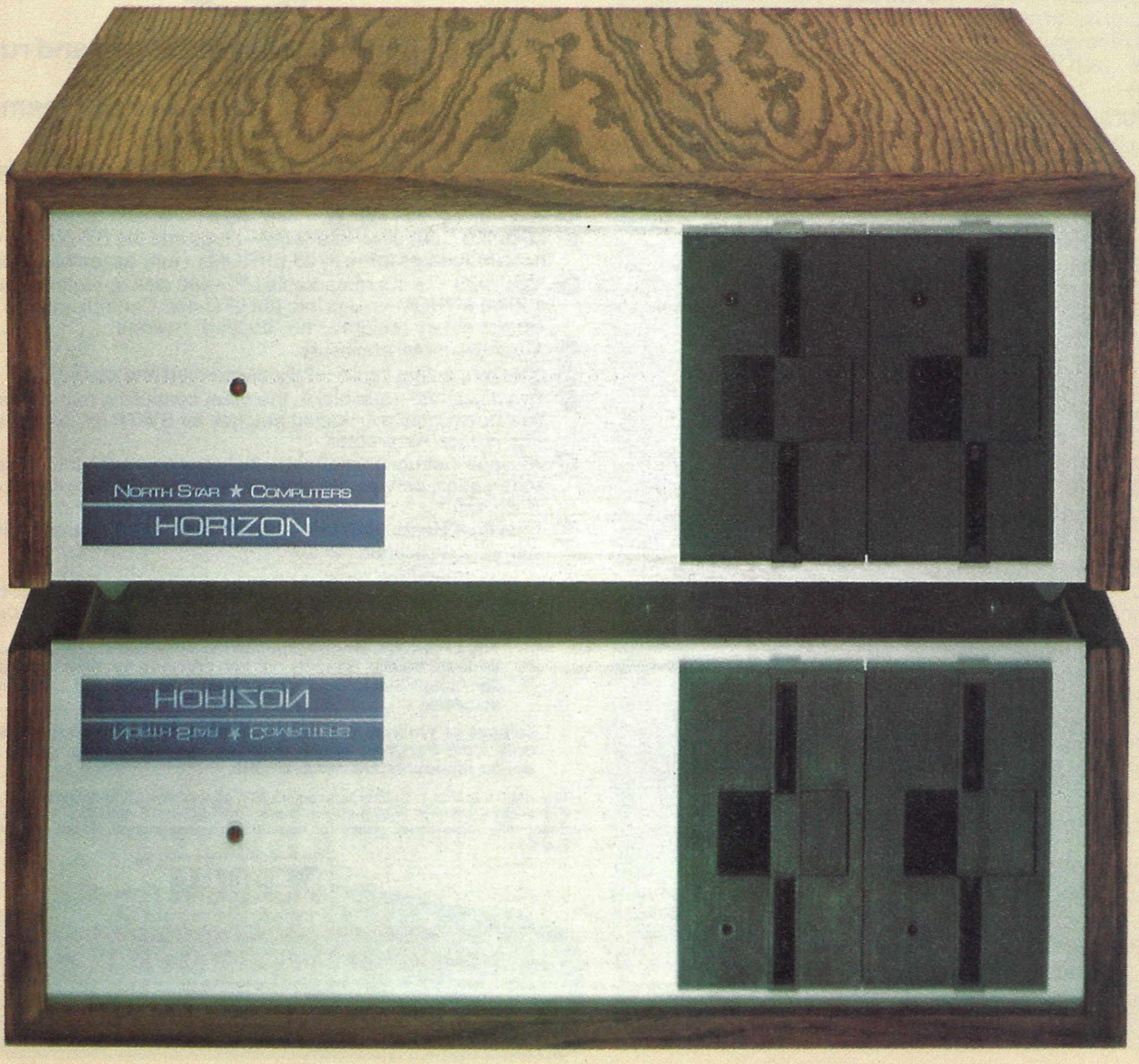

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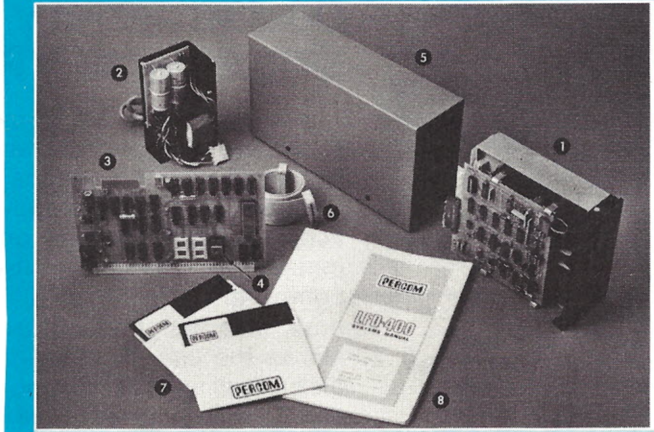

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Contest!

It was the best of times. It was a year for contests—and our "best article of the month" contest concludes its first year of existence with this issue. However, we'll start all over again with the next issue, so keep your voting judgement keen. You'll need it now because it's time to vote for the best article of the past year.

Please survey the list of winners and vote for the *one* that, in your opinion, is the best. Use whatever criteria you wish, and vote for only one article. We'll tabulate the ballots we receive, and the author of the article receiving the most votes will win $500. Then we'll throw all the ballots into a bin, mix them up and pull out one. Winner in that drawing will receive a lifetime subscription to *Kilobaud*.

The deadline for balloting is January 1, 1979; all votes received after that date will be invalidated. The winner will be announced in the March 1979 issue.

Before we list the year's winners, we want to congratulate R. M. Law and D. C. Mitchell, authors of September 1978's winning article: "(Con)text Editor."

Following is the list. To vote, turn to the reader-service card at the back of the magazine. In the proper space, enter the month in which your choice for best article appeared (remember: only one vote). While you're on the reader-service card, don't forget to vote also, in the space provided, for the best article in this month's issue.

Thanks for your participation in this contest. Keep voting.

"3D Computer Graphics," Artwick, Oct 77, p. 50

"Build the $35 Modem," Lange, Nov 77, p. 94

"File Structures Simplified," Yulke, Dec 77, p. 106

"The TRS-80: how does it stack up?" Juge, Jan 78, p. 44

"Interfacing Tips," Boyd, Feb 78, p. 72

"Build the 'Simple Computer'," Whipple, Mar 78, p. 16

"CP/M Printer," Stewart, Apr 78, p. 30

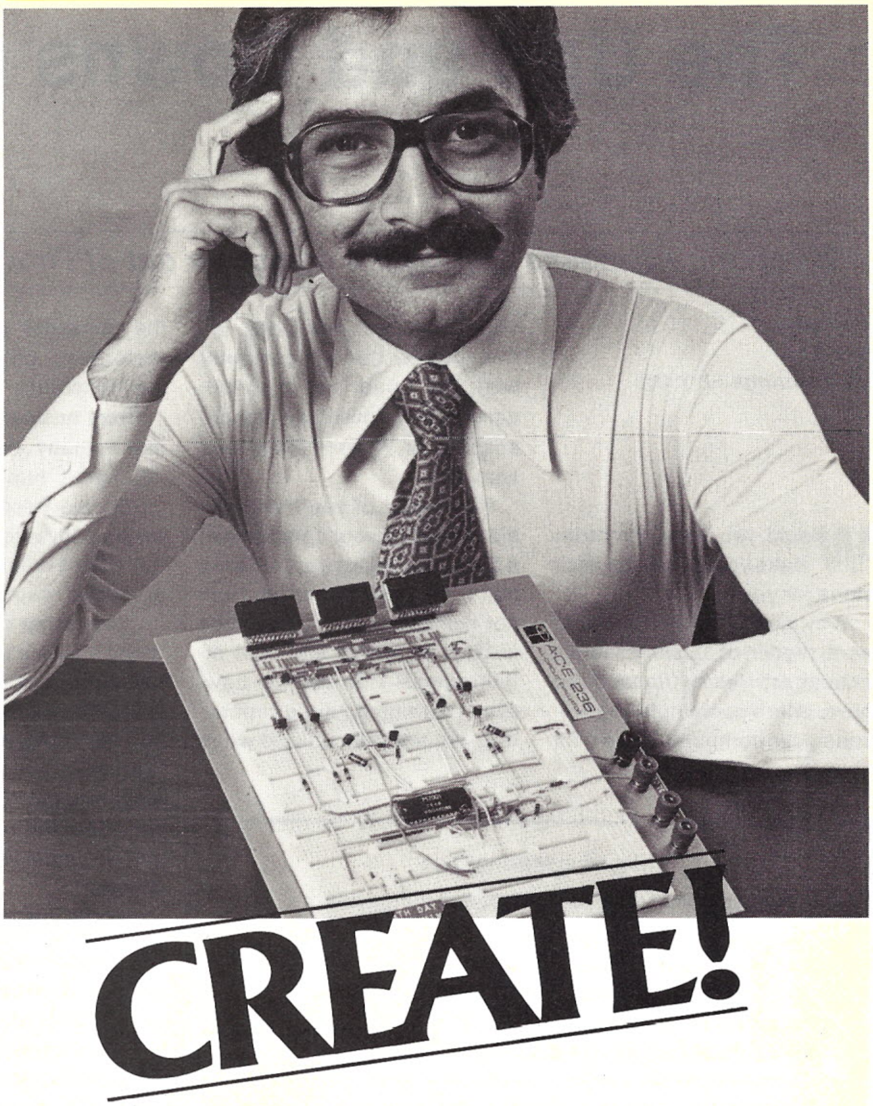
"PET's First Report Card," Wells, May 78, p. 22

"8080, Z-80 or 8085," Slater, Jun 78, p. 52

"Compatibility and the Altair Bus," Fuller, Jul 78, p. 100

"DOCUFORM," Fitchhorn, Aug 78, p. 22

"(Con)text Editor," Law, Mitchell, Sep 78, p. 22



The Ups and Downs of Business

Computer lib means getting the computer out of "housekeeping" and into business.

Jim Wright
Box 8348
Coral Springs FL 33065

Would you let a computer make your business decisions for you?

Why not? Chances are that as a reader of business-applications articles in *Kilobaud* you have, or are contemplating purchasing, a computer system for your business. The odds are even greater that the computer will be used for payroll, accounting, inventory, record keeping or other clerical-type activities.

How many of you have considered using your computer as a decision-making tool? Please don't misunderstand me; I am not demeaning the computer's clerical expertise and cost effectiveness. I do believe, however, that a computer's capabilities are not fully utilized when the computer is relegated to performing only "housekeeping" functions.

Every businessperson has to make many decisions daily. "Should I hire more people? . . . Do we need to deplete or build up inventory levels? . . . Is it the right time to invest in new or added capital equipment? . . . Should we extend our bank credit?" While I agree that your computer cannot make all of these decisions for you, it can be your invaluable staff assistant able to quickly absorb large amounts of data and convert it into information to assist you in your decision-making process.

Before continuing on and describing one area where the computer can be very helpful in converting your firm's data into information to help you evaluate your decision alternatives, let's see how well you currently make decisions on typical business problems.

The accompanying business decision-making quiz will present you with four different scenarios. Each scenario requires you to make Yes or No decisions. Your company's profile is given below to provide you with a little background.

In order to gain the most from the following, please take a few minutes to think through each scenario and decision shown at the left. Make each decision as though *you* are running the company and your salary is based on a percentage of the company's profits. (If you don't want anyone to see your answers, jot them down on a piece of scrap paper, but be sure to answer each decision.)

Company Profile

You are running a company that manufactures an appliance-type product. Your company has two competitors who are selling nearly identical products. Your market share is about 40 percent and has been very stable because your competitors' products are priced about the same as yours, and their new products are introduced right after your new-product announcements. Historically, your company's sales growth has been two to three times the economy's rate of growth. Now, back to the quiz.

Before you start to argue about the answers, let's review the same four scenarios and decisions, but this time with some added information. This new information is the ability to look into the future (i.e., forecast).

Fig. 1 shows your company's

Decision-Making Quiz

A. Business is at an all-time high, and things just couldn't be better. Would you:
  1. Build up inventory levels? Yes No
  2. Place a freeze on hiring? Yes No
  3. Buy the new machines you have had in your expansion plans? Yes No

B. Business has been sluggish lately, but sales are still well ahead of last year's. In fact, to keep up with the business level, you have had to subcontract some of your work because you are operating at your plant's capacity. Would you:
  1. Begin to reduce your work force? Yes No
  2. Convert part of your plant to produce a new product? Yes No

C. Business has started to decline and appears to be going down even further. You have just had to reduce your work force. Would you authorize commencement on an 18-month construction project for added plant capacity? Yes No

D. Business has been declining for 12 months. Sales are below last year's level. Would you:
  1. Start to rehire people you had to lay off four months ago? Yes No
  2. Sell off excess inventory at a slight loss? Yes No
  3. Plan to open a new distribution center in the next six to nine months? Yes No

The answers are: A(1) No; A(2) Yes; A(3) No; B(1) Yes; B(2) No; C Yes; D(1) Yes; D(2) No; D(3) Yes.

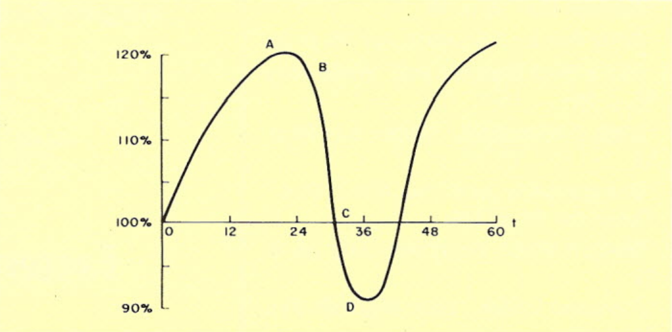


Fig. 1.

business growth rate over the time period of all four scenarios. The time scale in Fig. 1 is in months. The graph is interpreted as follows: Time t = 0 shows 100 percent. This means that sales in that month were exactly the same as sales were one year earlier. At t = 12 sales were 115 percent of the sales at t = 0; at t = 24 sales were 120 percent of the sales at t = 12; at t = 36 sales were only 90 percent of the sales at t = 24; etc.

If we assume that sales at t = 0 were 1000 units, we could convert the above percentages to units. Unit sales at t = 0, 12, 24, 36 and 48 would be, respectively, 1000, 1150, 1380, 1242 and 1428. The A, B, C and D points in Fig. 1 show the time at each of the scenarios.

Now that you have the information in Fig. 1, would you still make the same decisions as before, or are there any that you would change? Armed with this business forecast, let's review the correct answers.

Scenario A is near t = 24. Business is indeed at an all-time high; however, look what is ahead—a business slump! Certainly this is no time to be building inventory levels or hiring more people. Also, there is no need to purchase any expansion equipment (unless it has a two-year lead time).

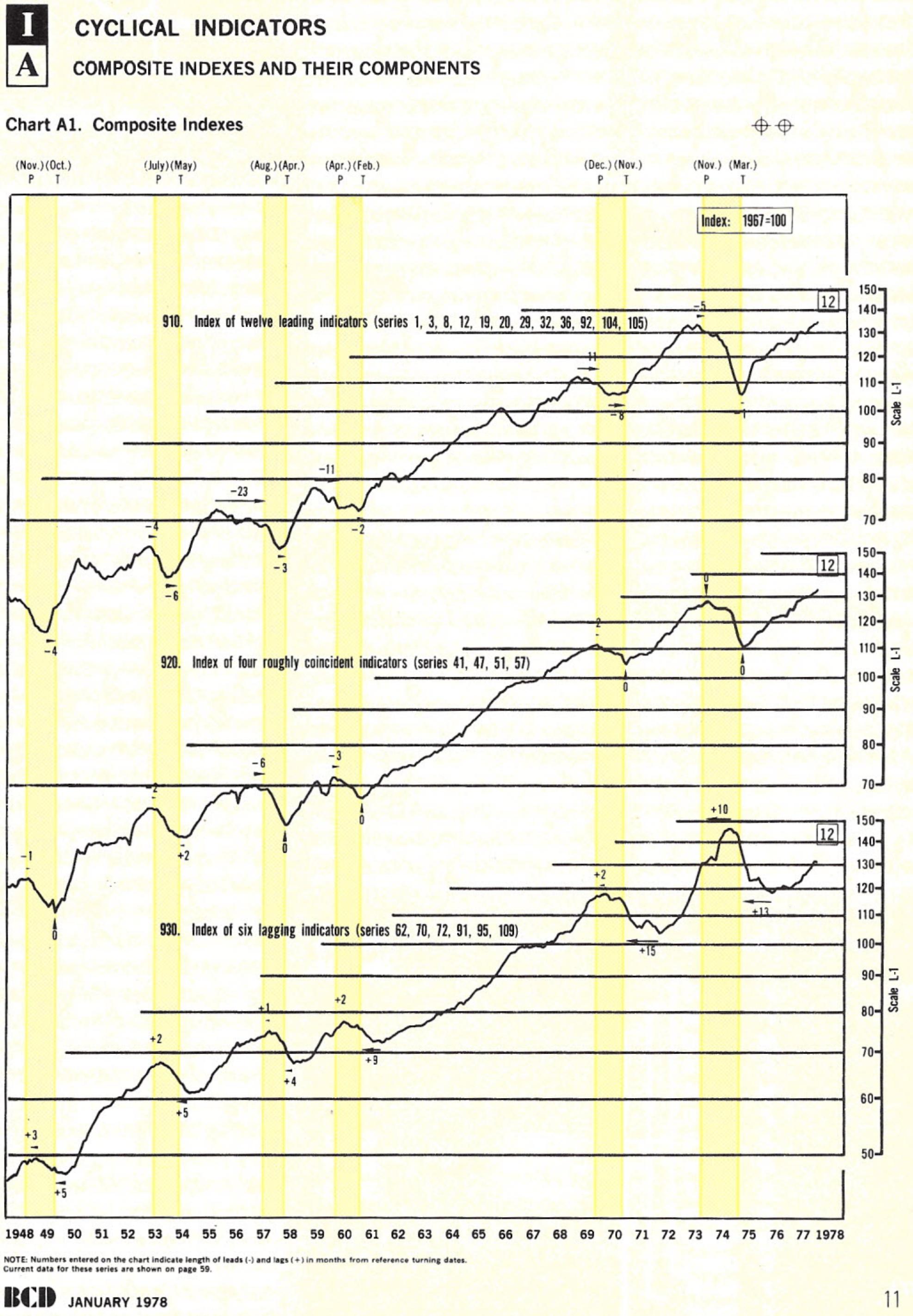
Scenario B is a period in which business is above plant capacity; but again, your business is headed for a rough next year. This is the time to start cutting back on marginal workers and begin preparing for the downturn that is to come. Remember, you can still use your subcontractors to maintain output until the downturn dictates a cutback on outside support. Spending capital to convert your plant to manufacture a new product should probably be postponed for nine to 12 months as sales will be declining and the added overhead costs of plant conversion will be a drain on profits (and your salary).

Note, however, that if the new product has significantly lower product costs, it is possible that the plant conversion costs and an increase in per-unit profits could be covered in a lower per unit manufacturing cost. If this was your analysis, a Yes answer to B (2) is accepted.

Scenario C is typically a period of panic and drastic cost-cutting. Business has been sliding and sales are just barely keeping up with last year's level. Because most companies were still building inventories and adding new equipment at A, they are now facing a severe profit squeeze. This is typically "solved" by cutting back on *all* costs. As the business is "uncertain" most business people elect not to spend money on a long-term construction project.

Once again, look out 18 months on the sales forecast (around t = 48). We see that business is again very strong; in fact, sales will be above the best level you ever had at t = 24 (1380). If you do not begin construction at C you will have insufficient capacity to handle this growth period.

By the time a company reaches scenario D it is usually willing to sell off "excess" inventory below cost just to maintain cash flow to pay the bills. Typically, survival is the only concern at this point. But with our sales forecast graph we see that everything is uphill from D. Now is the time to get back those people just laid off. (The


I A CYCLICAL INDICATORS

COMPOSITE INDEXES AND THEIR COMPONENTS

Chart A1. Composite Indexes

NOTE: Numbers entered on the chart indicate length of leads (-) and lags (+) in months from reference turning dates. Current data for these series are shown on page 59.

BCD JANUARY 1978 11

Fig. 2.

last people you had to let go were probably excellent workers and will be sought by others as soon as the turnaround begins.)

You will also be needing your inventories for the upcoming growth period so don't sell them off, especially at a loss. Also, as sales in a year will be at a new all-time high, now is the time to plan for that new distribution center to handle the expected growth.

If you initially made all the correct decisions, you have an excellent grasp of the business-cycle phenomenon (or are a lucky guesser). In either case you have maximized your salary! If you made most decisions incorrectly the first time don't feel bad; you are probably in the majority.

Most business people do not consider the impact of the business cycle in making decisions. Most business decisions are based on an extension of what has happened in the near past (i.e., the last six to 12 months). The turning points associated with a business cycle, therefore, are usually "overrun" in making decisions. It is typically six to 12 months before "corrective actions" are taken.

I suspect that most of you, after using Fig. 1, found it much easier to make the correct decisions in each scenario. How then can you create a business-cycle graph for your own firm and use it to improve your decision making? The remainder of this article will describe the business cycle and discuss one method of using your computer to analyze your firm's business history so you will be in a better position to forecast your firm's future activities and make more profitable decisions.

The Business Cycle

The National Bureau of Economic Research (NBER) defines business cycles as "expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle." NBER has dated the peaks and troughs of business cycles since 1854. During this time there were 28 complete cycles averaging about 33 months of expansion (i.e., trough to peak) and 19 months of contraction (i.e., peak to trough).

Although the term cycle creates an image of a regular pattern, the business cycle, unfortunately, does not have a consistent time period. Cycles have been as short as 28 months (March 1919—July 1921) and have extended out to 117 months (February 1961—November 1970).

Each peak and trough represents a "turning point." This is a point at which the general direction of a business or economy changes direction. Turning points, as we saw in the previous scenarios, can be of prime importance in making business decisions.

Fig. 2 is from the Department of Commerce's *Business Conditions Digest*. It shows the leading, coincident and lagging indicators from 1948 to present. Also shown in the shaded area are NBER's defined recession periods (peak to troughs). These indicators will provide an idea of the general cyclical nature of the economy.

		Raw Data	Sum	12mma (Sum/12)
1970	J	52153		
	F	52468		
	M	52250		
	A	51120		
	M	52586		
	J	52910		
	Jl	52718	625211	52101
	A	51734	627489	52291
	S	52547	630263	52522
	O	50552		
	N	50267		
	D	53906		
1971	J	54431		
	F	55242		

Table 1.

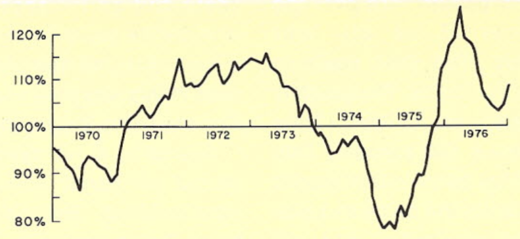


Fig. 3a. Pressure curve using raw data.

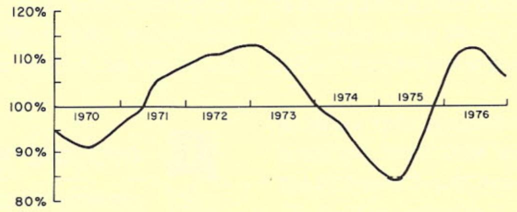


Fig. 3b. Pressure curve using averaged data.

Because turning points are several years apart we tend to forget or ignore their existence. This is especially true during periods of expansion. Most business people want to believe that growth will continue ad infinitum. There is always a reluctance to forecast a downturn, especially when you have to tell this to your boss. Even though turning points may be unpopular, they are a fact of business life. As NBER has documented, business cycles have been around for many years, and they are likely to continue to be around for years to come.

While NBER's definition describes the business cycle of the general economy, each firm in the economy has its own business cycle. Many firms such as auto-makers tend to follow the economy's direction very closely. Others may be totally out of phase with the economic cycle (e.g., unemployment compensation offices). Still others may have a small sales variation due to the business-cycle effect. These firms such as staple food suppliers may find that the business cycle has very little impact on their sales and can be ignored.

The point to be made is that you should understand the impact of the business cycle on your firm (or product lines within a firm) and then relate this to the general economy. Do not assume that the firm's cycle will follow that of the economy; check it out.

The Pressure Curve

One method to visualize a firm's business cycle is by using a "pressure curve." Pressure curves are an excellent method as they depict the rate of change of growth. While a raw data series will also show the effect of a business cycle, it will be masked by the seasonal, trend and irregular factors that are contained in a raw data series.

A pressure curve as shown in Fig. 1 is a graph of the ratio of sales (or any other variable) in a particular period compared to sales in some previous period. Normally in analyzing a business, the time period is monthly and the comparison is to the same month a year earlier (e.g., June 1971 to June 1970).

Because most businesses have seasonal and irregular fluctuations in their monthly data, the historic data series is first averaged. This averaging will smooth the raw data such that the resulting pressure curve will appear as a con-

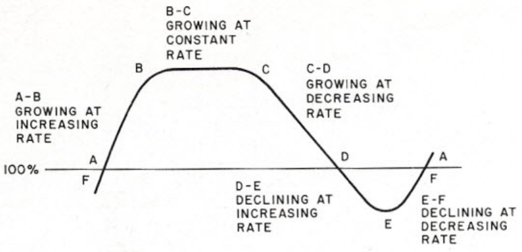


Fig. 4. Pressure curve periods.

tinuous line rather than a series of jagged lines connected together (see Fig. 3).

The traditional pressure curve is a "12/12 pressure curve." A 12/12 pressure curve first uses a 12-month moving average to smooth the raw data. It then compares each month of the averaged series to the data 12 months earlier.

Other pressure curves used are 1/12, 4/4 and 1/4. These are, respectively, unaveraged (raw) monthly data compared to the same month a year earlier, four-quarter moving averaged data compared to the same quarter a year earlier and raw quarterly data compared to the same quarter a year earlier.

While the other pressure curves are easier to calculate (manually), they do not provide as smooth a curve as the 12/12 pressure curve. Fig. 3a is a 1/12 curve, and Fig. 3b is a 12/12 curve.

Table 1 shows how a 12-month moving average is calculated. The first 12 months of the raw data series (January 1970-December 1970) are added together and then divided by 12. The resultant 12-month moving average (12 mma) data point is normally shown as July 1970 in the 12 mma series. This would be known as a "centered" series (i.e., the 12 mma point is placed in the "center" of the series January 1970-December 1970). If you compare a firm's series to any economic series, a centered series should always be used.

Sometimes it is easier for someone to visualize a 12 mma series by placing the above calculated data point in December 1970. This can be easily understood as being the average of the past year's (12 months) sales. A series shown this way represents an "uncentered" series.

The second point in the 12 mma series—August 1970 (centered)—is calculated by subtracting January 1970 from, and adding January 1971 to, the 12-month sum calculated above. This new "moving" sum is again divided by 12. The remaining points are calculated in the same manner (by dropping off one raw data point at the beginning and adding one to the end).

Note: In a 12 mma series there are 12 data points "lost." In a centered series six are at the beginning and six at the end.

Once the raw data series has been converted to a 12 mma series, the pressure points can be easily calculated. This is done by dividing each monthly data point in the 12 mma series by the data point for the same month one year earlier, (e.g., January 1973 12 mma point by January 1972 12 mma point).

This ratio is then multiplied by 100 to convert it to a percentage. Once all the pressure points have been calculated, they can be plotted to produce a pressure curve that will graphically depict the firm's cyclical nature.

Pressure-Curve Features

As pointed out in the description of the pressure curve in Fig. 1, pressure curves show the growth rate of a data series. From observation of a pressure curve you can easily tell if a particular data series is growing or declining and if it is at an increasing, constant or decreasing rate (see Fig. 4).

Another characteristic of the pressure curve is that it also shows the annual growth rates and their pattern. The July points in a centered series (December points in uncentered series) represent the annual growth rate of a firm. This can be easily seen by recalling that these pressure points are calculated by comparing the 12-month sums of two consecutive years.

By looking at the "axis" line of a pressure curve you can analyze the overall long-term trend of a firm (is the firm growing at a constant rate, an increasing rate or a declining rate?). To visualize this last statement consider a zero growth data series with each data point equal to 5120. Each point in the 12 mma series would also be 5120, and each pressure point would be 100 percent. This would result in a straight horizontal line at 100 on a pressure curve.

By going through similar calculations for constant growth, increasing growth and declining growth series, you will be able to see that these various long-term firm trends will show a straight line.

To determine the long-term trend, you can look at a pressure curve and mentally visualize a straight line running through its axis. If a more accurate depiction of the long-term trend is desired, the pressure curve can be analyzed using standard straight-line regression analysis. Fig. 5 shows various trends contained in pressure curves.

What Will Happen

Now that you have a method to visualize your firm's historic business cycle, how can you estimate its future shape and direction? Unfortunately, there is no simple answer. First you should carefully study the historic graph of the pressure curve over the past several business cycles looking for repeating patterns. Are the peak-to-peak cycles reasonably consistent in time? How many months are spent going from peak to trough, trough to peak, peak to the 100 percent line, peak to the "axis" line, etc.?

Through close examination of several past cycles, you should be able to construct a reasonable estimate of future activity. Remember, your main concern in using a pressure curve is to determine where you are in the current business cycle and how soon it will be before you are likely to encounter a turning point. Also, don't expect to pinpoint the exact timing of a turning point. Estimating a turning point within several months will still better equip you in making

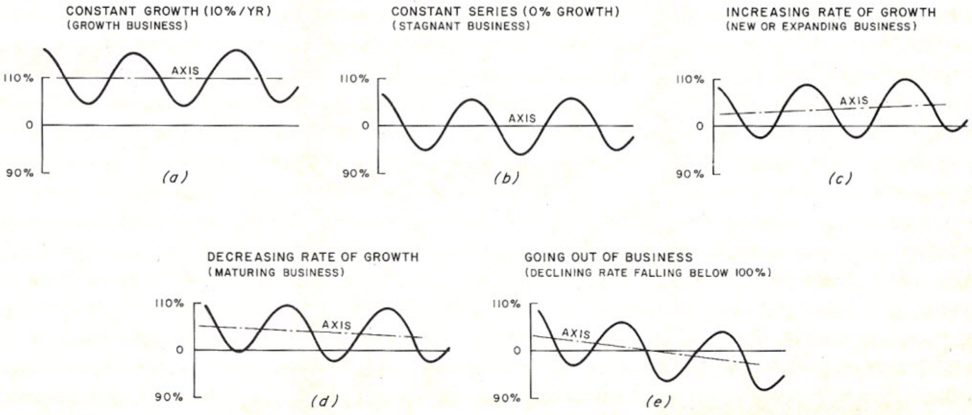
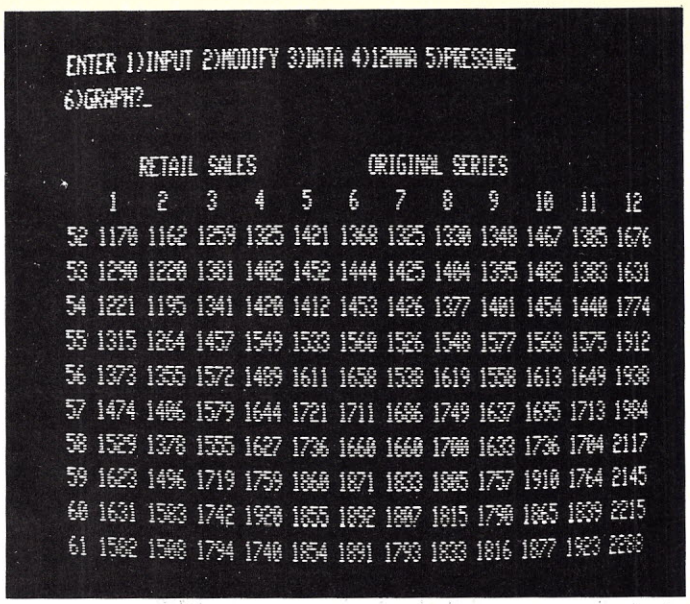


Fig. 5.

```
1   CLS
2   P.AT128:P.AT0;"ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE"
3   P.AT64;"6)GRAPH";
5   IN.A:IFA<5T.Z = A
8   ONAGOS.10,50,46,70,80,100:G.2
10  CLS:B = 0:B$ = ORIGINAL SERIES
12  IN."INPUT FROM 1)KEYBOARD 2)TAPE";A:ONAG.14,40:G.12
14  IN."TITLE(16 CHAR MAX)";A$:IN."# DATA POINTS(60MIN-120MAX)";E
15  IN."1ST YEAR EG 1967";T:GOS.90:M = 1:Y = T:Q = 0
16  F.I = Q + 1TOE
17  IFB>0T.52
18  P.AT0;"ENTER DATA FOR";M;Y;:IN.A(I):IFM<12T.22
20  Y = Y + 1:M = 0
22  IFA(I)>9999T.26
24  GOS.95:M = M + 1:A(E + I) = A(I):P.AT15:N.I:G.30
26  P.AT45;"MAX VALUE = 9999":G.17
30  P.AT128;SAVE ON TAPE 1)YES 2)NO";:IN.A:ONAG.32,39:G.30
32  IN."REWIND TAPE PRESS PLAY/REC ENTER 1";A
34  P.#A$;",";E;",";T:F.J = 0TOES.12
36  P.#A(1 + J);",";A(2 + J);",";A(3 + J);",";A(4 + J);",";A(5 + J);",";A(6 + J)
37  P.#A(7 + J);",";A(8 + J);",";A(9 + J);",";A(10 + J);",";A(11 + J);",";A(12 + J)
38  N.J
39  RET.
40  IN."REWIND TAPE PRESS PLAY ENTER 1";A
42  IN.#A$,E,T:F.J = 0TOES.12
43  IN.#A(1 + J),A(2 + J),A(3 + J),A(4 + J),A(5 + J),A(6 + J)
44  IN.#A(7 + J),A(8 + J),A(9 + J),A(10 + J),A(11 + J),A(12 + J)
45  N.J
46  B$ = ORIGINAL SERIES
47  GOS.90
48  F.I = 1TOE:GOS.95:A(E + I) = A(I):N.I:RET.
50  GOS.46:P.AT0;"1)CHANGE VALUE 2)ADD DATA";:IN.A:ONAG.52,62:G.50
52  P.AT128:P.AT64:P.AT0:"ENTER YR,MO,NEW VALUE AS 67,3,6876"
53  IN.Y,M,V:IFY>100T.52
54  B = 1:IFV>9999T.26
56  A((Y - (T - 1900))*12 + M) = V:IN."ANOTHER VALUE 1)YES 2)NO";A
58  ONAG.52,60:G.56
60  R = 387:C = 0:GOS.48:G.30
62  P.AT0;"HOW MANY NEW POINTS MAX = ";120 - E;:IN.N:Q = E
64  E = E + N:GOS.91:R = 387:C = 0:F.I = 1TOQ:GOS.95:N.I
65  I = INT(Q/12):M = INT((Q/12 - I)*12 + .1) + 1
66  B = 0:Y = T + I:GOS.16:RET.
70  F.I = FTOG:A(I) = - .321:N.I:B$ = 12 MO MOVING AVG
72  GOS.90:F.I = 1TOE - 11:F.J = ITOI + 11
73  C = 30
74  A(E + I + 6) = A(E + I + 6) + A(J)/12:N.J:N.I
76  F.I = E + 7TOG - 6:A(I) = (A(I) + A(I + 1))/2:GOS.95:N.I
78  A(G - 5) = - .321:RET.
80  IFZ<4T.GOS.70
82  B$ = PRESSURE LEVELS
84  GOS.90:F.I = G - 6TOE + 19S. - 1:A(I) = A(I)/A(I - 12)*1000:N.I
86  F.I = FTOE + 18:A(I) = - .321:N.I:C = 30:R = 451
87  F.I = E + 19TOG - 6:GOS.95:A(I) = A(I)/10:N.I:Z = 0:RET.
90  R = 387:C = 0:CLS
91  F = E + 1:G = 2*E:P.AT264;A$,B$:A = 1
92  F.I = 323TO381S.5:P.ATI + 1;A:A = A + 1:N.I
93  F.J = 1TOE/12 + .99:P.ATI + 1;T - 1901 + J;:I = I + 64:N.J:RET.
95  P.ATR + C;INT(A(I) + .5);:C = C + 5:IFC = 60T.99
97  RET.
99  R = R + 64:C = 0:RET.
100 CLS:IN."ENTER MAX & MIN SCALE VALUES EG 10000,0 ";H,L
101 A = T:S = 1:P.AT202;A$,B$
103 IFH<100G.105
104 H = H/10:S = S*10:G.103
105 L = L/S
113 P.AT194;"X";S;:P.AT256;H:P.AT896;L
115 F.I = 963TO1020S.6:P.ATI;A;:A = A + 1:N.I
117 F.J = 256TO832S.64:F.I = 4TO58S.6
119 P.ATJ + I;"- - - - - +";:N.I:N.J
120 F.I = 12TO43:S.(6,I):S.(127,I):N.I
121 F.J = 7TO127:S.(J,43):S.(J,12):N.J
122 W = 0
123 F.I = 1TOE:P = (S*H - A(E + I))/((S*H - S*L)/30) + 13
125 IFA(E + I) = - .321G.144
126 IF(W = 0) + (ABS(W - P)<1) + (A(E + I - 1) = - .321)G.143
127 IFP<WG.129
128 F.J = W + 1TOP:S.(I + 6,J):N.J:G.143
129 F.K = W - 1TOPS. - 1:S.(I + 7,K):N.K
143 S.(I + 7,P)
144 W = P:N.I:RET.
```

Program listing.



```
ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_

      RETAIL SALES          ORIGINAL SERIES
     1    2    3    4    5    6    7    8    9    10   11   12
52 1170 1162 1259 1325 1421 1368 1325 1330 1348 1467 1385 1676
53 1290 1220 1381 1402 1452 1444 1425 1404 1395 1482 1383 1631
54 1221 1195 1341 1420 1412 1453 1426 1377 1401 1454 1440 1774
55 1315 1264 1457 1549 1533 1560 1526 1540 1577 1568 1575 1912
56 1373 1355 1572 1489 1611 1658 1538 1619 1558 1613 1649 1938
57 1474 1486 1579 1644 1721 1711 1686 1749 1637 1695 1713 1984
58 1529 1378 1555 1627 1736 1660 1660 1700 1633 1736 1704 2117
59 1623 1496 1719 1759 1860 1871 1833 1885 1757 1910 1764 2145
60 1631 1583 1742 1920 1855 1892 1807 1815 1790 1865 1839 2215
61 1582 1588 1794 1740 1854 1891 1793 1833 1816 1877 1923 2288
```

Photo 1.

decisions than if you give no consideration to the business cycle.

Another method used to forecast a firm's future cyclical activity is to review the business cycle patterns of economic, industrial or trade series and/or indices. There are a number of such series being forecast by various associations. Once you find a historic pattern that matches your firm's, you can use the forecasted numbers to create an extension to the historic series and, therefore, determine your firm's future direction.

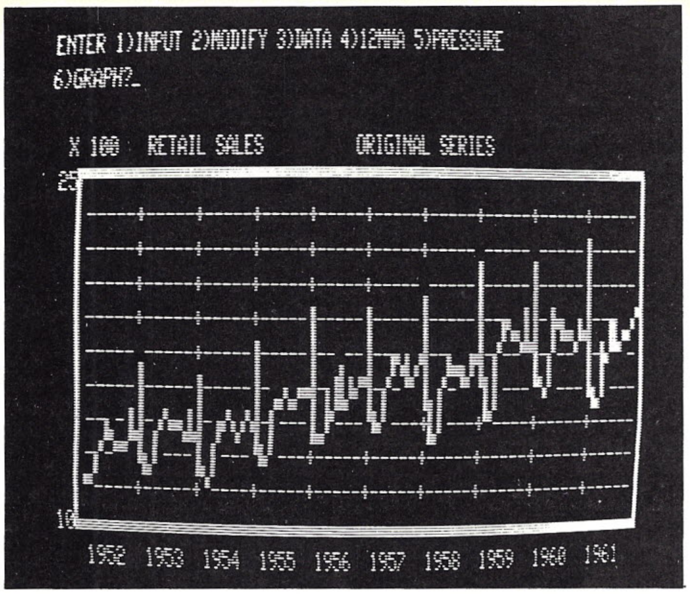
In looking for a series that matches your firm's, it is more important to find a *pattern* (i.e., peak/trough, trough/peak, etc., timings that coincide or, preferably, lead your firm's at the turning points). Do not be too concerned about the absolute values matching, but pay particular attention to the turning points.

There are two U.S. Department of Commerce publications that are very helpful in evaluating various series. The *Survey of Current Business* is a monthly publication ($19 per year) that contains data on economic, commodity, construction, trade, labor, finance, etc., series. Also published monthly is the *Business Conditions Digest* ($40 per year). The *BCD* graphically provides many time series used in forecasting and cycle anaylsis.

These publications are in most business libraries or can be purchased through the Superintendent of Documents, U.S. Government Printing Office. As a supplement to the *Survey of Current Business,* DOC publishes *1975 Business Statistics* ($6.80). This contains the historic series from 1947 to 1974 for those shown in the *Survey.* Although pressure curves provide annual growth data, their main usefulness is in determining turning points. To forecast the quantitative levels of future business, other techniques such as regression, etc., should be used in conjunction with a pressure-curve analysis.

Application Program

This section will describe the program, which will calculate and graphically display pressure curves for up to 10 years of monthly data. This program was written in Radio Shack TRS-80 Level I BASIC and will run on 4K RAM. Note: While this program requires 2588 bytes as written, you should be



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ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_
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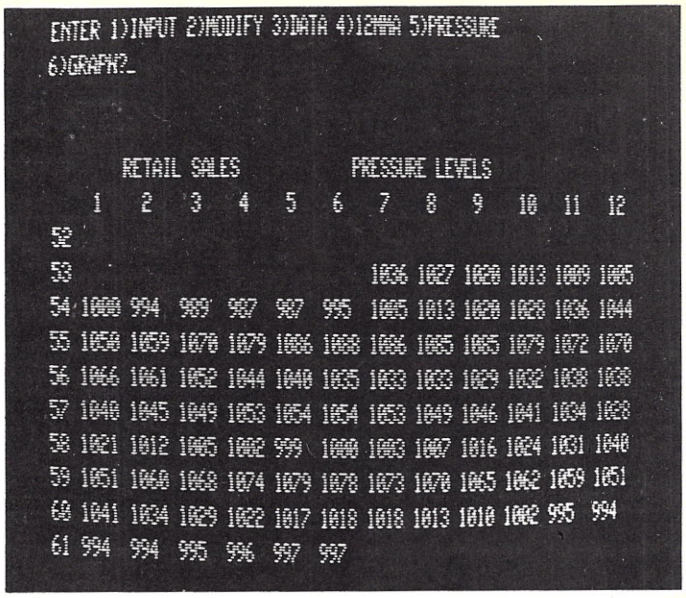
Photo 2.



```
ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_

        RETAIL SALES            PRESSURE LEVELS
     1    2    3    4    5    6    7    8    9    10   11   12
52
53                                1036 1027 1020 1013 1009 1005
54 1000 994  989  987  987  995  1005 1013 1020 1028 1036 1044
55 1050 1059 1070 1079 1086 1088 1086 1085 1085 1079 1072 1070
56 1066 1061 1052 1044 1040 1035 1033 1033 1029 1032 1038 1038
57 1040 1045 1049 1053 1054 1054 1053 1049 1046 1041 1034 1028
58 1021 1012 1005 1002 999  1000 1003 1007 1016 1024 1031 1040
59 1051 1060 1068 1074 1079 1078 1073 1070 1065 1062 1059 1051
60 1041 1034 1029 1022 1017 1018 1018 1013 1010 1002 995  994
61 994  994  995  996  997  997
```

Photo 3.

careful when typing it into a TRS-80 with 4K, as almost all of the remaining 995 bytes of memory will be required to hold 10 years of data.

Since this program was written to analyze a number of data series, special emphasis was placed on creating a flexible input program that will allow the user to change data values or update a data series. The input routine also allows the user to store his data on tape or to read data from a tape.

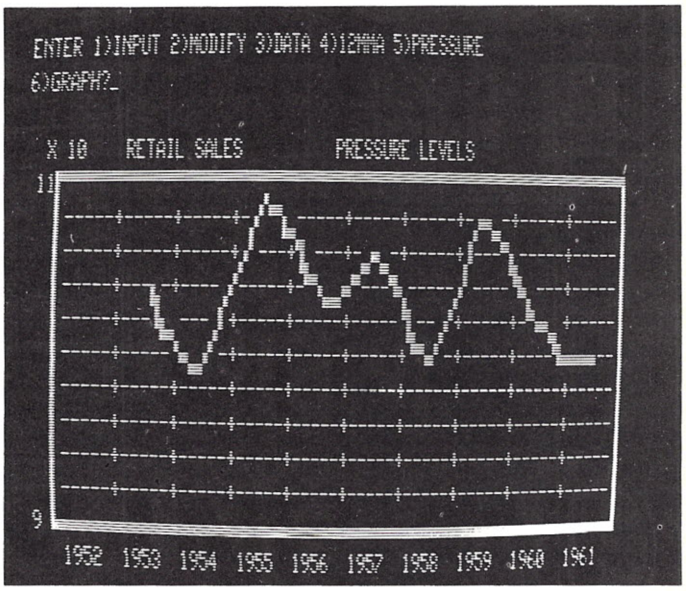
The program is completely interactive and can be used even by those without special training. Each portion of the program will prompt the user to respond with his desired selection. Each section of the program provides the user with a table showing the original data input or the calculations just performed. While this table displays all data rounded to four figures, this is only for display purposes. All data is carried in the program to six significant figures.

Probably the most useful feature built into this program is its ability to draw a graph of the data shown in any of the tables. With the graphing routine the user can quickly determine the cyclical nature of his business. Photos 1-4 show the tables and graphs displayed through this program. At the top of each photo you can see the program prompt given at the end of each completed task.

Statements 10-48 form the INPUT program. This subroutine prompts the user whether he wants to enter data from the keyboard or tape. If entry is from the keyboard, the user specifies the title, number of data points and the beginning year (statements 12-15). The program will then draw a table (subroutine 90) and prompt the user for the month-by-month data points (statements 16-26). As each point is received, it will be displayed in the table (subroutine 95).

To prevent table overflow, the maximum value allowed is 9999. If your data is larger than this (e.g., 3589763), each data point should be scaled by an appropriate factor of 10. The above data point would be entered as 3589.763.

Note: As the TRS-80 allows only six significant figures in Level I, the last three will be lost. For most series this should pose no problems. Statements 30-39 provide the user a method to save his data on tape. This can be done after the data has just been input or after data has been corrected/updated in the MODIFY subroutine. If the user chooses to enter data from tape, the program is directed to statements 40-48.



```
ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_
```

Photo 4.

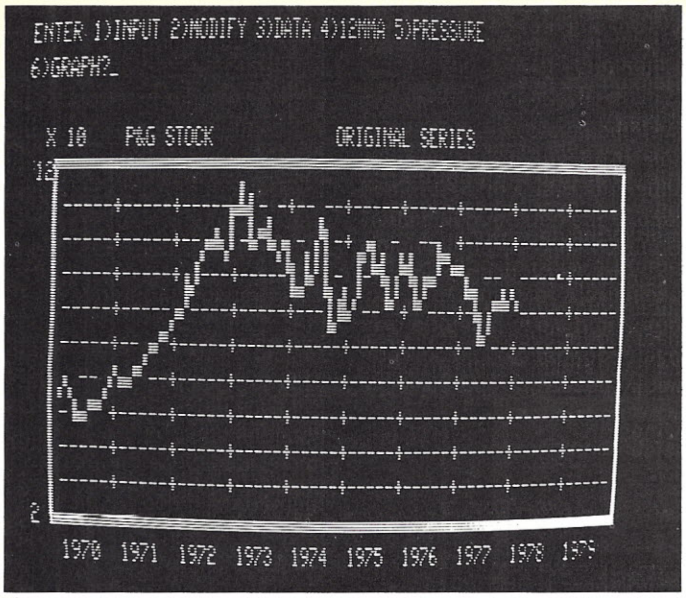
Correcting any input errors or updating values in the data series can be accomplished in the editing or MODIFY subroutine. Statements 50-66 provide for this feature. When changing a value (or values), statements 52-58 will keep track of all new values and, after all editing is complete, will display the new values in the table (statement 60). The user then is asked if he wants to save the new data on tape.

When the table is updated (statements 62-66), the table is updated with each entry, just as in the input subroutine. The new table can also be saved on tape.

The third program choice, DATA, will display the original series table without having to use the INPUT or MODIFY routines.

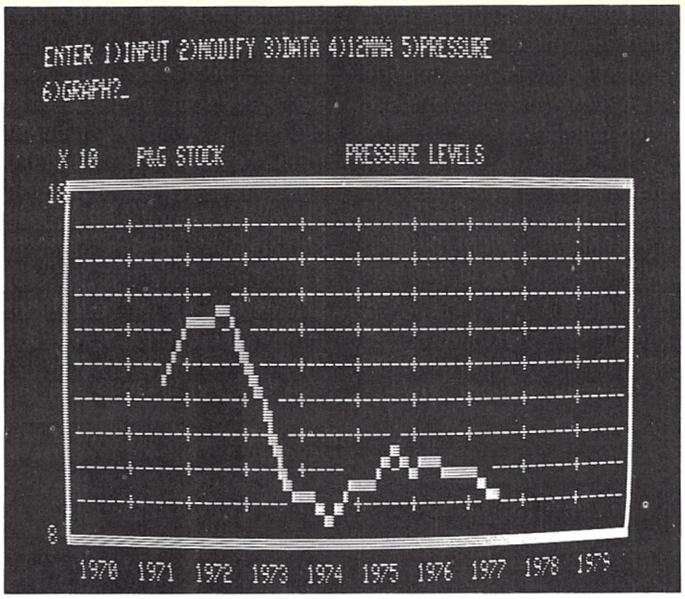
There are two computational subroutines, 12MMA and PRESSURE. Statements 70-80 calculate the 12 mma of the original series. This subroutine provides a refinement to the calculations shown in Table 1. This refinement is used to better center a series of even numbers (i.e., 12 months of data).

Looking at Table 1, you can see that the first data point,



```
ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_
```

Photo 5.



```
ENTER 1)INPUT 2)MODIFY 3)DATA 4)12MMA 5)PRESSURE
6)GRAPH?_
```

Photo 6.

52101, is "centered" midway between June and July, even though it is shown in July. To overcome this you can add 52101 and 52291 together and divide by 2. This new point is properly centered in July. Statement 76 provides this additional averaging.

Note: Since there are several loops involved in this 12MMA routine, the calculating time runs about one minute.

Statements 82-87 calculate the pressure points. In order to provide better definition in the table, the pressure points are displayed multiplied by 10 (e.g., a 100 percent point is shown as 1000). Again, this is for display only; the value in the program is in terms of 100 percent. This is important to remember when you run the graph of the pressure curve. In both the 12MMA and PRESSURE routines, the "blank" values on the screen are filled with a dummy value, −.321, which is used in the graphing routine.

The 100 series statements provide the GRAPH command. To provide the most flexibility, the user is allowed to specify both the maximum and minimum point on the graph. Some care should be used when you pick these scales to make it easier to read values in between. There are 10 divisions on the graph; therefore, the difference between the high and low points divided by 10 should come out to an easily understood value.

In writing automatic scaling routines, I have found that the values 1, 2 and 5 or any multiple of 10 work very well. With the ability to set the high and low limits, it is easier to expand the pressure curve and observe the turning points.

The −.321 dummy value inserted in the 12MMA and PRESSURE routines is used in the graphing routine to skip over nonprinted values. This has the effect of starting the graph anywhere on the display at the first valid data point.

Conclusion

This article presented one tool to help better understand the business cycle and its effect on a business. While the examples used were mainly sales related, a pressure curve can be used to analyze any type of data to look for cyclical effects. Photos 5 and 6 show how this program has been applied to a stock series to look for cyclical factors. Once a business cycle has been identified, you are in a better position to make decisions by knowing approximately where you are in the current cycle. ■

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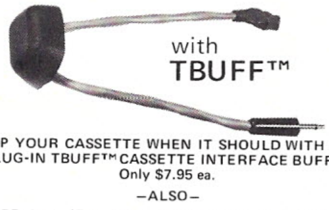

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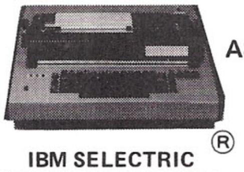

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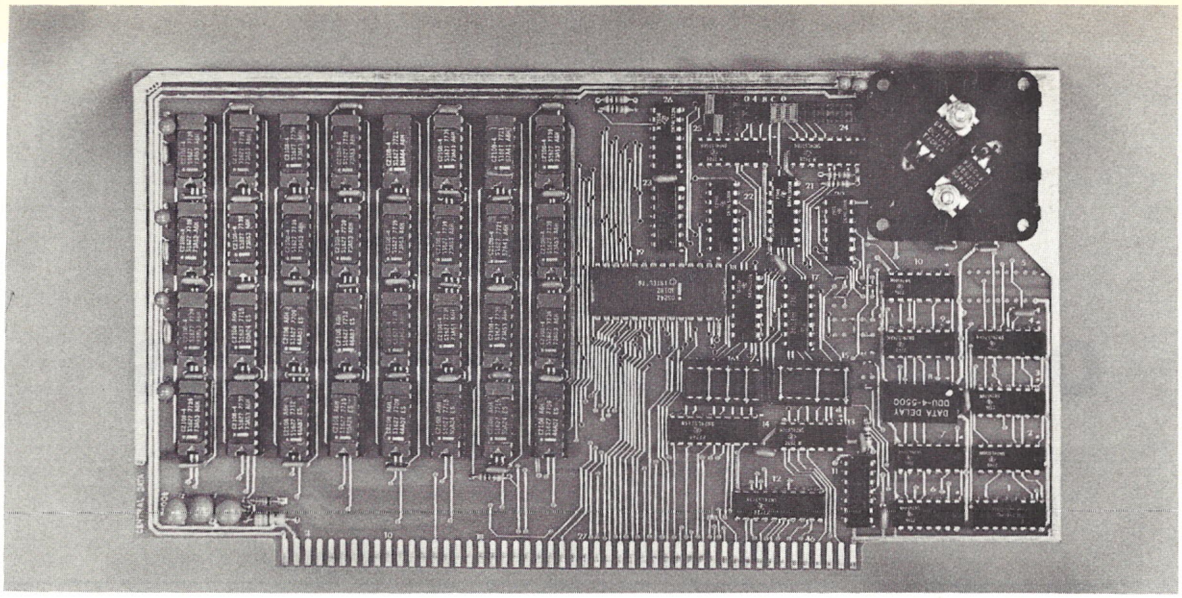

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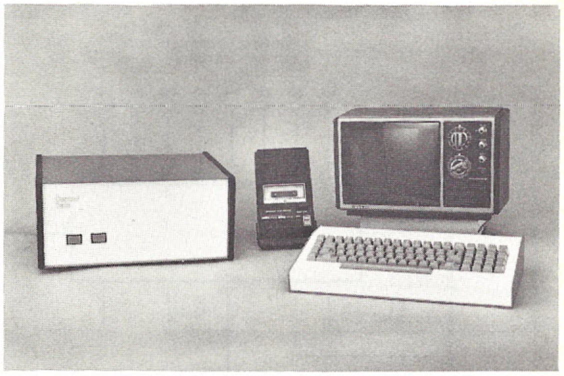

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BASIC Control of Servomechanisms

Computers control jumbo jets—why not model-airplane and other small motors?

Gary Sabot
38 Woodland Rd.
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Have you ever wanted to be able to control small motors with your computer, but could not because you did not know how to use machine language? Well, if your BASIC has the OUT command (which sends a number to an output port), then your wish can come true.

This article will explain how to interface the common three-wire model-airplane servo to your computer. You can purchase this type of servo either from a hobby shop or from Heathkit, which sells three different models for only $26.95 each in kit form.

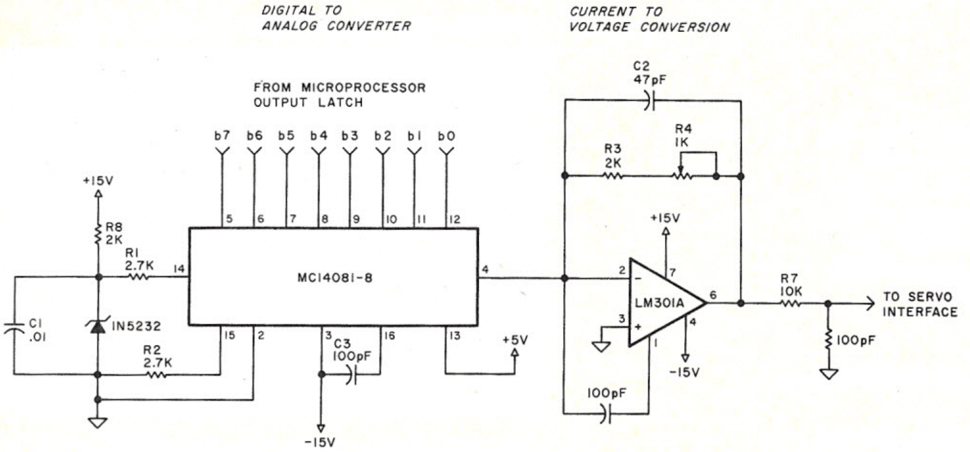


Fig. 1. Circuit diagram of a compatible DAC.

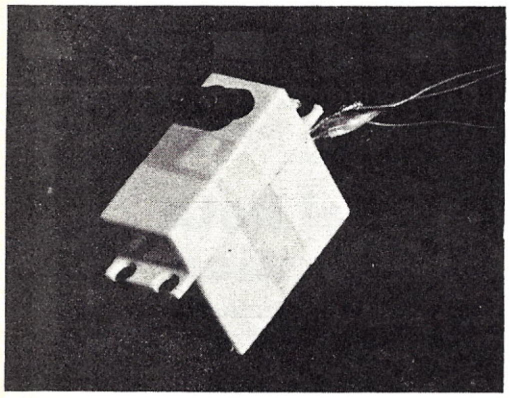


Photo 1. A typical servo. (Photos by Eric Parker)

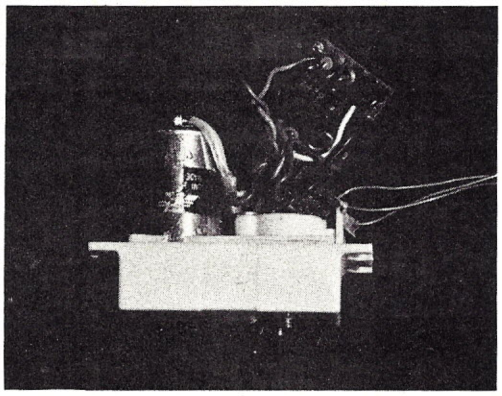


Photo 2. Inner works of a servo.

The model-airplane servo seems to be tailor-made for use in conjunction with a computer. First of all, it can be powered by a 5 V source and consumes little current. This means it can utilize the power supply of your computer. Second, it is digitally controlled by a TTL-compatible signal. Therefore, it can be easily interfaced with digital ICs. In addition, while a model-airplane servo is lightweight, usually under three ounces, it still packs a powerful punch, usually having at least four pounds of thrust. (See Photo 1.)

How the Servo Operates

As I have indicated, the servo is controlled by a TTL-compatible input line. The servo "looks" for a pulse train on this line. Depending on the width of each pulse, the servo adjusts its rotor's position. These pulses must be between one and two milliseconds long or the servo will do what is known as "stalling," which is damaging to the servo.

By carefully varying the width of these pulses, you can control the position of the servo's rotor. For example, if pulses one ms wide were fed into the servo, the rotor would turn to one extreme of its 90 degrees of rotation; if pulses two ms wide were fed in, the rotor would revolve to its other extreme. But it is not limited to just these two positions, since, by sending in pulses of a deter-

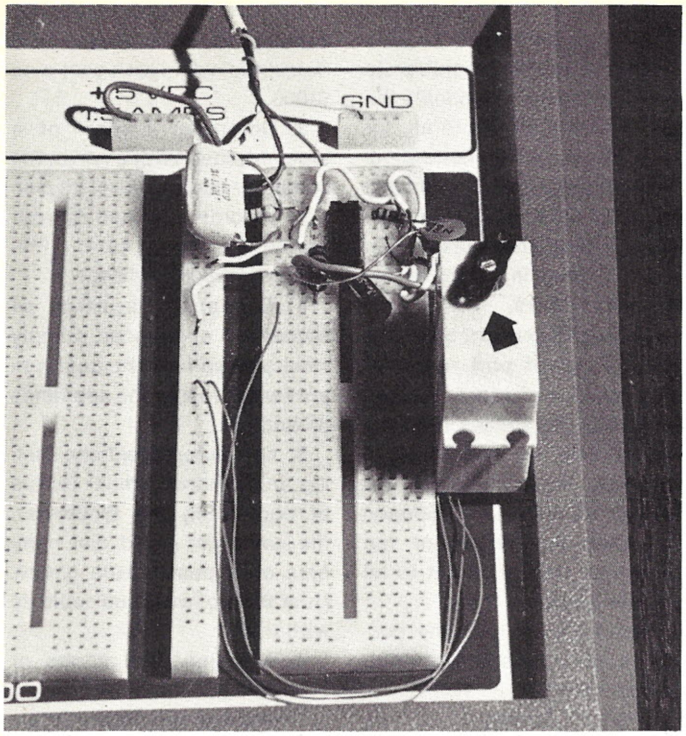


Photo 3a. *This is the servo interface with 0 V being applied to its input. Notice arrow pointing to rotor.*

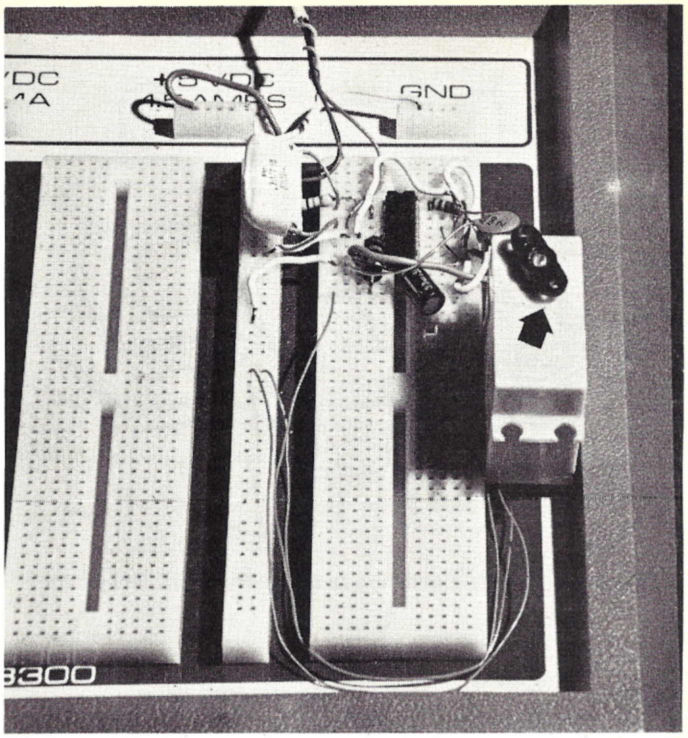


Photo 3b. *Interface with 5 V being applied to its input. Arrow shows how rotor has moved.*

mined width, we can place the servo's rotor at any point within its 90 degree range.

An important question now appears: How can a computer generate pulses of a desired width without resorting to machine-language timing routines? The answer: By using my circuit, of course!

Requirements of My Circuit

My circuit is controlled by an analog voltage between 0 and 5 V. This obviously means that your computer must have a digital-to-analog converter. If your computer is not equipped with a DAC, the circuit in Fig. 1 (which is taken from *The Best of Byte*, pg. 225) should, according to its specifications, work, although I have not personally built it and tested it with my circuit.

Circuit Description

IC1, the 556, contains two 555 timers. One of the timers is used to generate pulses at a rate the servo can accept. These pulses are then fed into the second timer, which is employed to modify their width. The width of the signal that emerges from the second timer is determined by the voltage it receives at pin 3. By simply connecting your computer's DAC to this pin, your computer can control the pulse width and, therefore, the servo.

By the way, the values of the resistors and capacitors (see Fig. 2), which control the operation of the two timers, were not arrived at by slaving over the 555's applications notes. In fact, when I first designed this circuit I was using potentiometers (variable resistors) instead of fixed value resistors, and I simply adjusted them until the servo worked. I then measured the values of the potentiometers with a VOM (volt-Ohm meter).

The resultant readings gave me the values for the resistors shown in Fig. 2. If you have a similar type of servo, but it will only accept a nonstandard input, try replacing my resistors with potentiometers and fiddle with them until your servo works.

Construction and Calibration

Since there are so few parts in this circuit, just about any construction technique can be used, including perfboard, PC board and wire-wrapping. But whatever technique you use, when you finish construction of the circuit the time has arrived to test it out. For testing purposes, instead of placing the output of the DAC at pin 3 of the 556, it is best to use a potentiometer. Put one end of the potentiometer at the ground of your computer's power supply; the other end at +5 V. Then place the potentiometer's wiper at pin 3. Assuming the servo is also connected, it is time for "The Smoke Test." (If it doesn't smoke, it's OK.)

Apply power to the circuit and move the potentiometer's knob back and forth. If the servo's rotor does not move in unison, try checking all of your wiring; then, if you cannot find anything wrong with it, try recalibrating it, as described in the circuit description section.

The second step in the calibration of this circuit is centering the servo. Look through your servo's instruction manual and read the section on how to center the servo. Then attach the output of your DAC onto pin 3 of the 556. With everything powered up, have the computer send the number 127 to the DAC. Since the DAC converts the number sent to it to a proportional voltage between 0 and 5 V, this action will cause the DAC to output 2.5 V, the midpoint of its range. Now, center the servo according to the instructions in your servo's

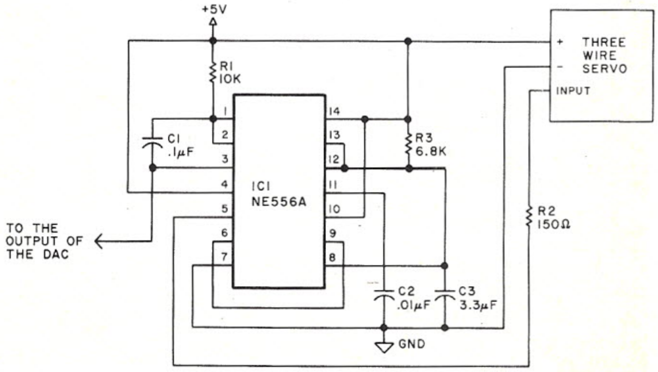
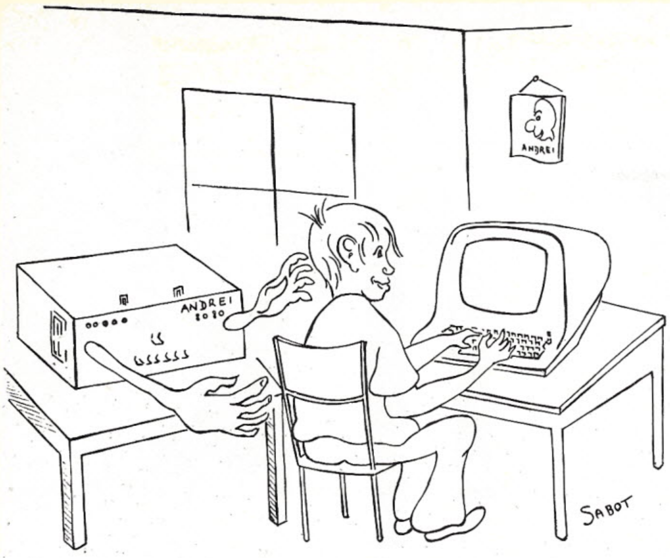


Fig. 2. Circuit diagram of servo interface.



Of course, there is a bad side to computer-controlled servos!

manual.

This completes the alignment section. Your computer can now control the servo. To control the position of the servo's rotor in a BASIC program, simply OUT a number from 0-255 to the DAC. The servo's rotor will automatically move to the correct position.

Applications

If you have begun to tire of watching your computer twiddle its servos (ha ha!), then it is time to ponder some serious applications.

Since many potential uses require more than one servo, that is one problem to be considered. A possible solution to this dilemma is to duplicate the entire circuit, DAC and all, for each servo to be controlled. While that is a good approach if you need only two or three servos, it quickly becomes a drain on your checking account for greater numbers.

A better idea might be to use another output port to select only one out of several servos to receive the pulses from my circuit. This will work because when a servo receives no pulses, its rotor is stationary. I'll leave the details of the design of such a circuit to all you geniuses out there.

Here is a list of some possible applications for a computer with servos.

1. An X-Y plotter.
2. Computer control of a typewriter. Two servos could position a solenoid over a typewriter key, and the solenoid would then strike the key. Although this would be unbearably slow (about two characters/second), it would work with any typewriter—not just IBM Selectrics, which can cost over $1000.
3. Computer control of a tape recorder. With a servo, the computer could control its own tape recorder, instead of your having to attend to it. (Phi-Decks are nice anyhow.)
4. Computer control of household appliances. Simply have a servo flick the appropriate switch to turn the appliance on and off.
5. Computer telephone dialing. In a manner similar to that of controlling the typewriter, the computer could dial numbers on a push-button phone. (Just think of what you could do with this!)
6. Anything with knobs or buttons.

As you can see, there is practically an unlimited number of applications for a computer with muscle. If you think of a particularly interesting application, write it up and send it in to *Kilobaud* so we all can enjoy it.■

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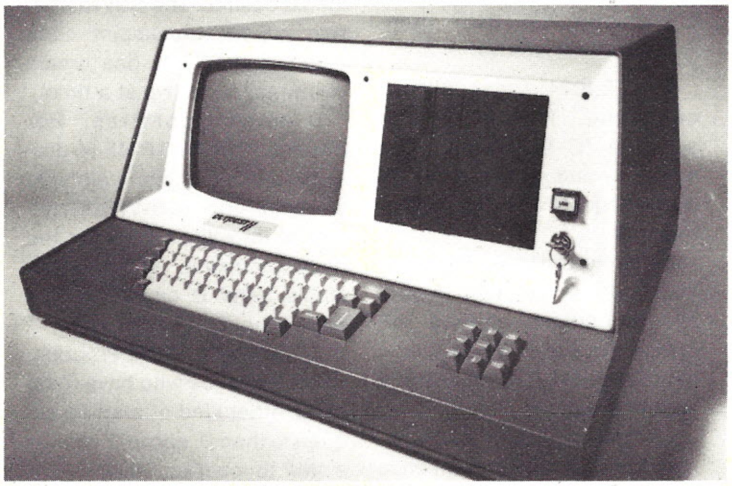

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Phil Hughes
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SWTBUG, a registered trademark of Southwest Technical Products Corporation, is a 1K ROM monitor program designed to be a MIKBUG-compatible improvement for 6800 users. It is compatible with software that uses up to 16 of the most common MIKBUG routines (see Table 1) and is an excellent improvement. The only hardware modification required to support SWTBUG is to connect address bit 9 from the old MIKBUG socket to address line 9 (previously, A9 of the MIKBUG socket was grounded in the SWTP MP-A processor board) and replace MIKBUG with SWTBUG.

MIKBUG Holdovers

For those not familiar with MIKBUG features, here are, briefly, those features which have been preserved with SWTBUG.

M—Memory Examine/Change. This routine allows you to display (and alter, if desired) any RAM location.

R—Register Dump. Displays the current contents of the pushdown stack. This contains the values that will be loaded into the registers if control is transferred to a user program via the G command.

G—Go to User's Program. Transfers control to a user's program by executing an RTI (return from interrupt) instruction.

P—ASCII Tape Punch. This command allows the user to write specified locations of memory to cassette or paper tape for permanent storage.

L—Tape Loader Function. This command loads paper or cassette tapes created by the P command.

SWTBUG Commands

The new SWTBUG commands are as follows:

C—CT-1024 Clear Screen command. This command sends a CT-1024-compatible home-up and erase-to-end-of-frame sequence to the control terminal.

J—Jump to User's Program. This routine transfers control to the address entered following the J (e.g., J1234 jumps to location 1234) by means of a JMP instruction.

E—End of Tape. This command is an added convenience for those using the P command. The contents of location hex A048 and A049 (the stacked program counter) are punched on paper tape or cassette followed by an end-of-tape marker compatible with the load command.

O—Optional Port. This command allows the user to install the cassette interface unit on a different port than the control terminal. This allows the control terminal to operate at up to 9600 baud (using an MP-S interface) and still be able to read Kansas City Standard cassette tapes through the MP-C control interface. (Note that not all existing software will support the MP-S interface on port 1; but you have to give a little to go from 300 to 9600 baud.)

B—Software Breakpoints. This command allows the user to use a single command to enter and remove breakpoints for debugging. This basic capability is available with MIKBUG, but requires much manual work to save old memory contents, enter an SWI (software interrupt instruction) and then remove it when it is no longer desired. The only restriction on the breakpoint command is that only one breakpoint may be active at a time.

D—Disk Bootstrap. For owners of the SWTP MF-68 disk system this command alone is worth the price of SWTBUG; the rest of us will hold out for the next command. Entering the single letter D causes a disk boot. What more can I say?

Z—Jump to PROM Program. For those of us who have to do some other kind of start-up sequence than D, above, Z causes a JMP to location C000.

F—Byte Search. This command allows you to search for a specified value in a byte within a specified address range. The addresses of all occurrences of this value are displayed.

Additionally, SWTBUG allows the user to vector SWI, IRQ and NMI interrupts to any location in memory, as well as use the character input and output (INEEE and OUTEEE) subroutines for I/O to any port configured with a serial (MP-S) or control (MP-C) interface. Patches are included for BLKJAK and CO-RES to allow them to work with the MP-S interface on the control port. BASIC through Version 2.0 cannot be modified to work with the MP-S interface (well, SWTP says it can't, anyway).

SWTBUG comes with an amazing 33 pages of documentation, including full source listings and new versions of three diagnostics. I, for one, think it's a super deal. ■

SWTBUG PROM, $19.95 postpaid, Southwest Technical Products Corp., 216 W. Rhapsody, San Antonio TX 78216.

LOAD19	-	Load error
BADDR	-	Input 4-digit hex number
BYTE	-	Input 2-digit hex number
OUTCH	-	Character output
INCH	-	Character input
PDATA2	-	String output
PDATA1	-	String output
OUT2H	-	Output 2 hex characters
OUT4HS	-	Output 4 hex characters and a space
OUT2HS	-	Output 2 hex characters and a space
START	-	System initialization
CONTRL	-	System reentry
MCLOFF	-	Reader off sequence
MCL	-	Carriage return, line feed, 3 nulls, a $ and a 04 string
INEEE	-	Character input
OUTEEE	-	Character output

Table 1. MIKBUG-compatible routines in SWTBUG (at the same locations).

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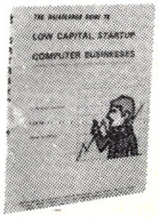

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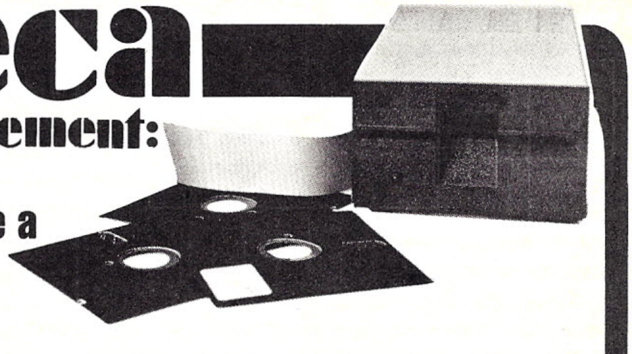

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How to Write Good Application Programs

This article shows a method of writing and documenting application programs . . . quite different from the way a hobbyist usually writes programs for his own use.

In the next few years we are going to see more and more small-business houses and firms using, or wanting to use, microcomputer systems, whose hardware costs are dropping lower and lower. This, in turn, will provide the computer hobbyist of today many chances to use his knowledge profitably. There is going to be a big demand for individuals who can write application software tailored to the needs of these small firms. So if we, present-day computer hobbyists, want to make use of these opportunities, then we should be able to write good programs. Well, what is a *good application program*, and how do we set about writing one?

What Makes a Good Program

The most important quality of a good program is that it works and works according to the given specifications. Don't rush off to write a program for someone after only the first meeting with the future user of the program. Do you fully understand his requirements? Put what you have understood on paper and show it to the user for verification.

Make absolutely sure that what the user requires and your understanding are the same before you start anything else. The work of these few hours might later save you days of labor! It is much better than having to rewrite an entire program just because of a small misunderstanding between you and the user.

Once this is done, find out the major functions required to solve the user's problem. Take each of these major functions and find out the lesser functions that derive from them. Then for each of these lesser functions find out the functions of a still lower level. Continue this procedure until you come to really simple functions, which need not be broken down further.

During the above process, don't worry about how a function will be coded later—the important thing is to identify all the functions required. This sort of designing is called *top-down design.*

A typical program might consist of three major functions: (1) input data, (2) process data, (3) output results. The first function itself might have to be further divided: (1) get data from the input device; (2) perform checks on the input data; (3) sort the input records. Now each of these could be broken down further; for example, the input-checking function itself would require a print function to indicate to the user that data had been input incorrectly.

Each function is put into a module. For documentation purposes make a chart, as shown in Fig. 1, showing the overall design. Then for each module show: (1) the inputs required (the inputs might be from some input device or data from other modules), (2) the main function of the module, (3) the name of the other modules called by this one, and (4) the output data (which again might be on output devices or passed on as input data to other modules).

Now that you know *what* is the data required and sent out by each of the modules, see *how* the data is going to be transferred in between modules. If you are using simple BASIC interpreters, then this is not a problem. But if you want to use compilers or assemblers, then it is absolutely essential to know the design of the interfaces between the modules. Otherwise, the coding of the program cannot begin. So decide and put into writing how the data is going to come in and go out of each module.

Plan of Program Attack

Next, plan how the data is to be input and output to the I/O devices. Decide in which order the data is to be input and which variables can be entered on the same line; if BASIC is not being used then find out the length of each variable or how the variables are to be separated etc. Plan the layout of the

output. Show the user your ideas on the input and the output. These are the two areas in which he is directly concerned—so the design should also be according to his convenience.

It is surprising what a large portion of the program consists of input and output. It is better to get the user's approval right now so that later on when the program is written no major changes have to be made. Ask the user to take some old data and rearrange it in the new format. This will be used to check the program you will write. Then think of all the checks you can make on the input data. For example, in a payroll program you could check that the hourly salary does not exceed a certain number. A small mistake, such as typing a number twice, could blow a program or, worse, unknowingly print wrong results.

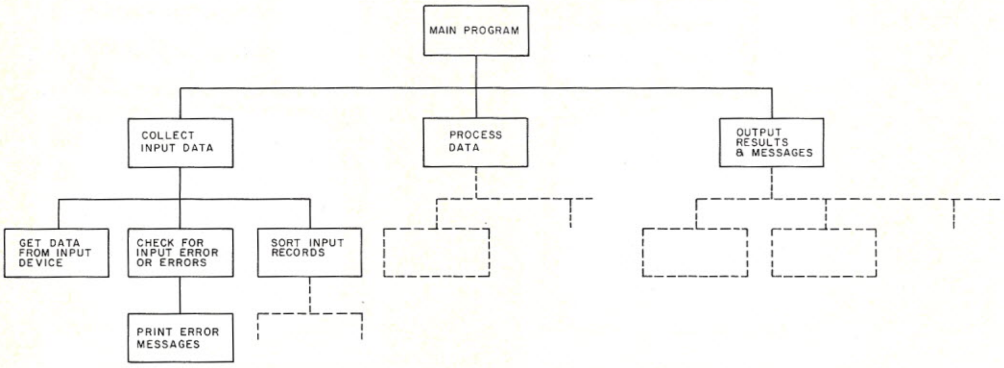

Fig. 1. Block diagram showing the overall design.

The next step is to make detailed flowcharts or charts using structured programming concepts for each of the modules. Always try to find a simple algorithm. Do not think too much about memory requirements and speed of execution unless these constraints are really critical. The charts should be easily understandable. Try to use as much English as possible. For example, write Salary = Hours Worked * Hourly Wages, rather than S = H * W.

If enough memory is available then use a higher language. It is *easier to understand*—and that is one of the good qualities of a program. Do not use clever tricks—leave them for programs for your own use. Write simply (use your judgement to distinguish between a simple and a sloppy program)—if anything might not be obvious then explain it.

In any case, always use a lot of comments to explain what you are doing. If the speed of a program is really important (very often it is not), concentrate on speeding up those frequently used portions of the program rather than the entire program.

Make your program *flexible.* Suppose the payroll program that you are writing is for a firm that has 100 persons and ten different categories of workers. In a few years the firm might have 200 workers in 15 different categories. Will your program be able to accommodate those changes? Try to envisage future expansions and take care of them whenever possible. Make your programs *easy to use.* The person using your program does not know how it runs. So precede input statements by telling him what data is expected. If there is an input error, then print messages explaining the error.

Then test your program with both correct and *incorrect* (to see if the input checks are working) data. Use the test data supplied by the user (you had asked him about this earlier) and check with his old results. If there are mistakes then correct not only your program but also the *flowcharts,* etc. Along with the flowcharts, add a table listing all the variables and their meanings.

Prepare a manual explaining how the program is to be loaded, which loader is required or which version of BASIC is needed, how much memory or what configuration of peripherals is necessary, how the data is to be input, what is to be done in case of input errors, the meaning of all error messages—in short, all the *operating details to run the program.*

Now that the program has been checked and the operating manual is ready, run your program for some time with current data alongside whatever method the user utilized in the past and compare and verify the results. This gives the user confidence in your program, and when he shifts over exclusively to using your program he will not be making a leap in the dark. And in a short time the user will be running the program independently with the help of the manual.

Helping the User

You will notice how much more explicit and formal you have to be when you write application programs for others. Often, when you write a program for yourself, the only things remaining after completion are the source listings and the program on some medium. In contrast, see how much more has to be given to the user:

1. Description of the problem.
2. General block diagram of the top-down design of the program.
3. The function, the inputs and the outputs of each of the modules of the above diagram.
4. Details of how data is transferred between the modules and the design of the input and output data (complete samples of the input and the output should be included).
5. Detailed flowcharts or other charts to show the workings of the program.
6. List of all the symbols used in the program along with their explicit meanings.
7. Source listings of the program. The comments in the program should make the program self-explanatory.
8. Cassettes or floppy disks or paper tapes containing the program.
9. Manual explaining how to run the program.

Keep a copy of everything you give to the user. It will help you to debug if problems crop up (and often bugs are detected after months); to help the user in case he loses something or if a floppy disk or a cassette tape gets damaged; to expand the program in the future; to *show your work to attract potential customers.* And if you are lazy, then you will soon notice that application programs of a particular type have a lot of similarity (i.e., most of the payrolls will have much in common). So why do all the hard work again and again when modifications to a working program will do the job?

Conclusion

Finally, it is a good practice to meet the user again *(without his asking you)* after some time to review the entire package. Find out if he has any difficulties—small changes in the input, some more output required or something in the operating manual not clear, for example—and try to help him. These changes will not take a long time as everything should still be fresh in your mind (if it is not then see your documentation before meeting the user). After making the changes do not forget to update the documentation. All this will help you find out the sort of problems a user has and also build up good relations with the user—and a happy customer not only comes back to you for his future requirements, he will also attract other customers for you. ■

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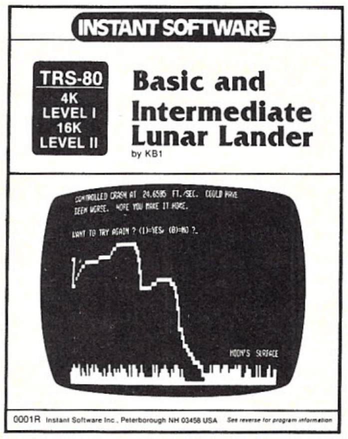

```
CONTROLLED CRASH AT 24.6585 FT./SEC. COULD HAVE
BEEN WORSE. HOPE YOU MAKE IT MORE.

WANT TO TRY AGAIN ? (1)=YES, (0)=NO ?_
```

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```
RUN 1=ROLL DICE, 2=REDRAW BOARD, 3=NEW GAME?_
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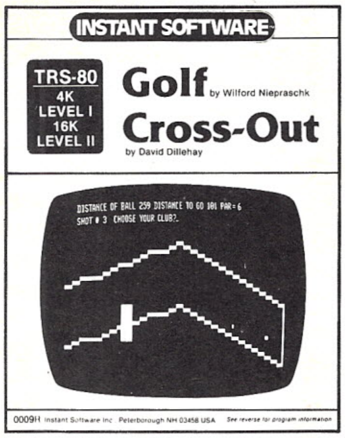
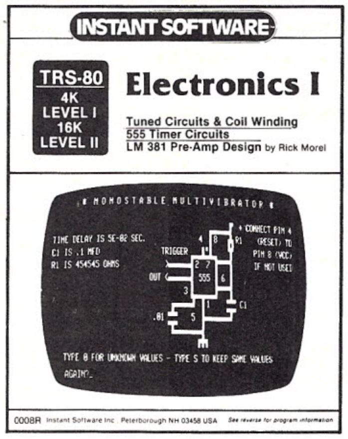


```
DISTANCE OF BALL 259 DISTANCE TO GO 101 PAR=6
SHOT # 3  CHOOSE YOUR CLUB?_
```

● GOLF/CROSS-OUT—by Wilford Niepraschk and David Dillehay. Playing golf on a computer? You bet and frustrating, too. You have your choice of seven clubs—three irons, three woods, a chip and a putter. The program has 18 different fairways, each diabolically designed. You have to pick the right club and angle for hitting the ball or else you end up in the woods or a trap. The green calls for putting skill. The program has excellent graphics and you'll have a ball . . . golf ball. **CROSS-OUT** is the old peg puzzle, but in computer form. You have to jump pegs, removing each one jumped. The idea is to end up with but one peg, and that one in the middle hole. The program will rate your skill at the end of each try. $7.95. Order no. 0009R.



```
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TIME DELAY IS 5E-02 SEC.
C1 IS .1 MFD
R1 IS 454545 OHMS

TYPE 0 FOR UNKNOWN VALUES - TYPE S TO KEEP SAME VALUES
AGAIN?_
```

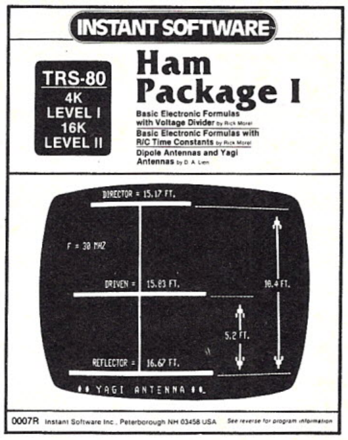
● ELECTRONICS I by Rick Morel. With this group of five programs you will be able to design coils for radio circuits, calculate the component values for tuned circuits, design preamplifiers using the LM-381 IC and timer circuits, either monostable or astable using the 555 timer IC.

Coils can be designed with the use of tables or special calculators, but they are difficult to use. This package has a coil designing program which is simple to use and the computer does all the work.

There is also a program for designing tuned circuits, audio or radio frequency—fixed or variable frequency.

The LM-381 program draws the circuit diagram and gives you the component values for your needs. It will calculate any unknown values for you. The two 555 programs do the same, giving you the diagrams for either one-shot timers or astable timing systems (clocks). It will do all the calculations for you, providing times or component values.

These programs are not only helpful around any workshop or lab, they also are wonderful for teaching the fundamentals of electronics to newcomers. $7.95. Order no. 0008R.



● HAM PACKAGE I by Rick Morel and D. A. Lien. This group of eight programs (we like to give you plenty) will be of frequent help to any experimenter or ham operator.

OHM'S LAW CALCULATIONS
FREQUENCY VS REACTANCE
SERIES RESISTANCES
PARALLEL RESISTANCES
SERIES CAPACITANCES
PARALLEL CAPACITANCES
DIPOLE DESIGN
YAGI DESIGN

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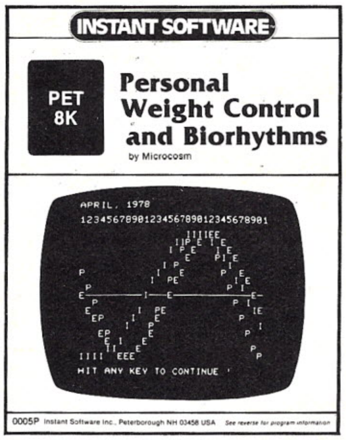

INSTANT SOFTWARE

PET 8K

Personal Weight Control and Biorhythms

by Microcosm

```
APRIL, 1978
1234567890123456789012345678901

HIT ANY KEY TO CONTINUE
```

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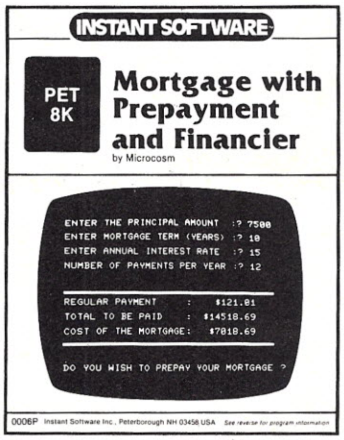

INSTANT SOFTWARE

PET 8K

Mortgage with Prepayment and Financier

by Microcosm

```
ENTER THE PRINCIPAL AMOUNT  :? 7500
ENTER MORTGAGE TERM (YEARS) :? 10
ENTER ANNUAL INTEREST RATE  :? 15
NUMBER OF PAYMENTS PER YEAR :? 12

REGULAR PAYMENT     :    $121.01
TOTAL TO BE PAID    :  $14518.69
COST OF THE MORTGAGE:   $7018.69

DO YOU WISH TO PREPAY YOUR MORTGAGE ?
```

0006P Instant Software Inc., Peterborough NH 03458 USA *See reverse for program information*

● **PERSONAL WEIGHT CONTROL/ BIORHYTHMS**—by Microcosm (for the PET™) Here's a program that will let you chart any individual's biorhythm cycle, showing physical, emotional, and intellectual highs and lows. If your neighbors find out you've got it, they will never leave you in peace. **PERSONAL WEIGHT CONTROL** is a must for the diet-conscious. Once your ideal weight has been determined, the program will calculate the correct daily caloric intake necessary to reach your goal over a certain time period. $7.95. Order no. 0005P.

$7.95 ea.

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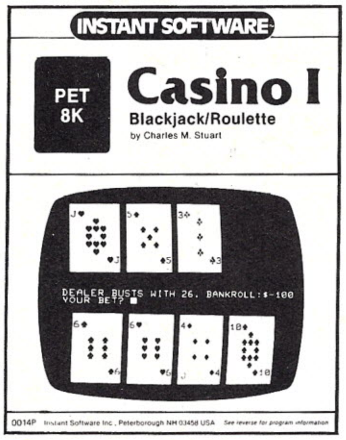
● **CASINO I** by Charles M. Stuart. There are blackjack games galore, but not many of them are so dependable that you can use them to prepare to make your fortune at Vegas. This blackjack program is not only fun to play, it is also tutorial and allows you to play every combination which you could play at the MGM Grand Hotel in Las Vegas.

There are several systems which will beat the house at blackjack, but before you go investing your cash in a get rich quick attempt, try out your system on this program and see how it does in actual practice.

Roulette programs are more difficult to find, yet this is another very popular casino game—and one you'll want to get some experience with before you venture to go up against the professionals at Vegas. Remember that there are a lot of people who have worked out systems to beat the house at these games and they make a comfortable living going to Vegas every now and then to rebuild their fortunes.

This roulette program is tutorial and gives you the odds on each type of bet.

All you need is the expertise and a little luck to go along with it and you'll pay for your computer in no time. $7.95. Order no. 0014P.



INSTANT SOFTWARE

PET 8K

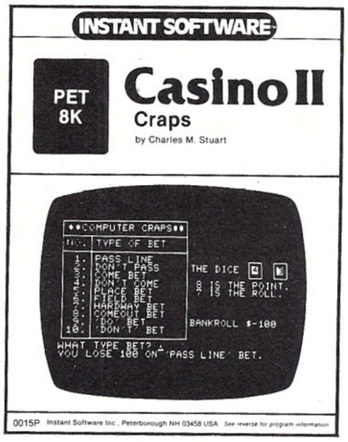
Casino I

Blackjack/Roulette

by Charles M. Stuart

```
DEALER BUSTS WITH 26. BANKROLL:$-100
YOUR BET? ■
```

0014P Instant Software Inc., Peterborough NH 03458 USA *See reverse for program information*



INSTANT SOFTWARE

PET 8K

Casino II

Craps

by Charles M. Stuart

```
**COMPUTER CRAPS**
NO.  TYPE OF BET
 1.  PASS LINE
 2.  DON'T PASS           THE DICE
 3.  COME BET
 4.  DON'T COME            8 IS THE POINT.
 5.  PLACE BET             7 IS THE ROLL.
 6.  FIELD BET
 7.  HARDWAY BET
 8.  COMEOUT BET
 9.  'DO' BET             BANKROLL $-100
10.  'DON'T' BET
WHAT TYPE BET? 1
YOU LOSE 100 ON 'PASS LINE' BET.
```

0015P Instant Software Inc., Peterborough NH 03458 USA *See reverse for program information*

● **CASINO II** by Charles M. Stuart—Yes, there are a lot of craps programs around—so why should you buy this one? The big difference is that this one is not just a crap game, it is also a tutorial program which will give you the odds on every type of bet so you can steer clear of the idiot bets that improverish the unwary. Did you know that there are bets which give the house as little as 0.8% advantage? It takes precious little luck to overcome such a slight edge—but you have to know where to find these bets before you can use them.

If you use this program to get experienced with craps you should be able to walk away from any craps table a winner. Once you know what bets to make and are able thereby to take the best advantage of lucky streaks, betting lightly to wait through the lean times, you'll have quite an edge.

This program uses the exact rules used at the MGM Grand Hotel in Las Vegas, so you'll be playing under actual gambling house conditions. You should be able not only to pay for the program, but also for your computer system the next time you go to Vegas or Atlantic City. $7.95. Order no. 0015P.

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Sharing Scheme for RS-232 Channels

"Share and share alike" is Bob's motto. Enjoy what he has to offer.

Serial I/O ports are expensive; so are the expansion slots they occupy in my computer system. If you are running out of either of these two assets, this article may be of some help.

I will describe a scheme to share a single serial I/O port with several different RS-232 peripherals, using simple, inexpensive diode logic that can be implemented in most computer systems without removing, adding, or altering a single PC board. I use this scheme to share the serial port in my 3P + S between a serial terminal and my National Multiplex tape system; I have also seen it used with a serial RS-232 matrix printer.

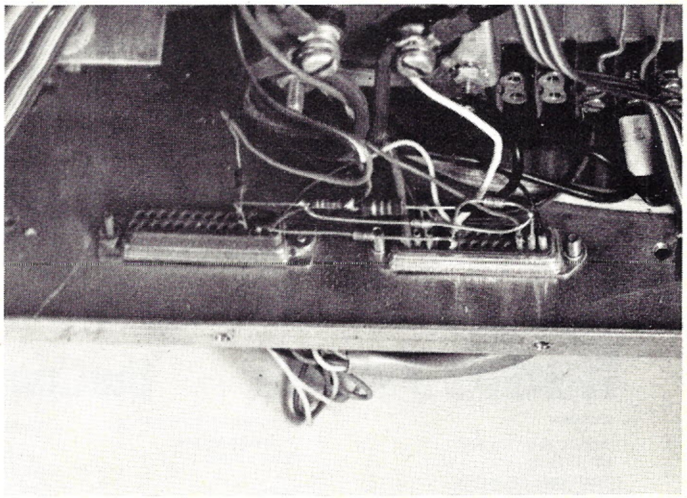
Fig. 1 is a complete schematic showing how, with the addition of two resistors and five diodes, I share an RS-232 line between terminal and tape systems. The scheme works by creating an imitation open-collector bidirectional data line on both the data-in and data-out wires. Both of these lines are normally pulled low by a resistor, and any device can pull the line high by asserting its RS-232 driver to a positive logic level.

Thus, the computer can simultaneously "talk" to the tape system and the terminal; the terminal can transmit to the computer and be recorded on tape at the same time, and data read from the tape drive can be displayed on the terminal at the same time it is read into the computer. The diodes are strategically placed to block all RS-232 drivers from pulling a line low while passing a high logic level into the bidirectional wire.

The system is operated by simply turning on all devices that you wish to be able to use with the serial lines at any given moment. When a device is off, it will not affect the line, and operation will be as if the line were not shared at all.

There are certain disadvantages to this scheme; the most obvious is noise immunity. The diodes eats up a tiny bit of the RS-232 signals applied so noise immunity is decreased slightly. I don't recommend using this method if there are noise problems in the unshared line before modification

Nevertheless, I have been using this trick in my system for over a year, and it has been used heavily on a microcomputer system I am familiar with at work . . . all without any problems whatsoever. If you enjoy saving a little money and space, you may like it as much as I do! ■



With the addition of a few diodes and resistors, you can share a serial I/O port between two or more peripherals.

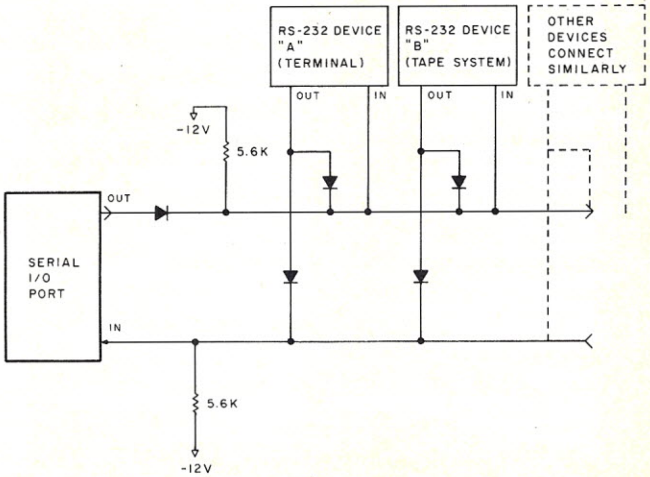


Fig. 1. Schematic of RS-232 channel-sharing.

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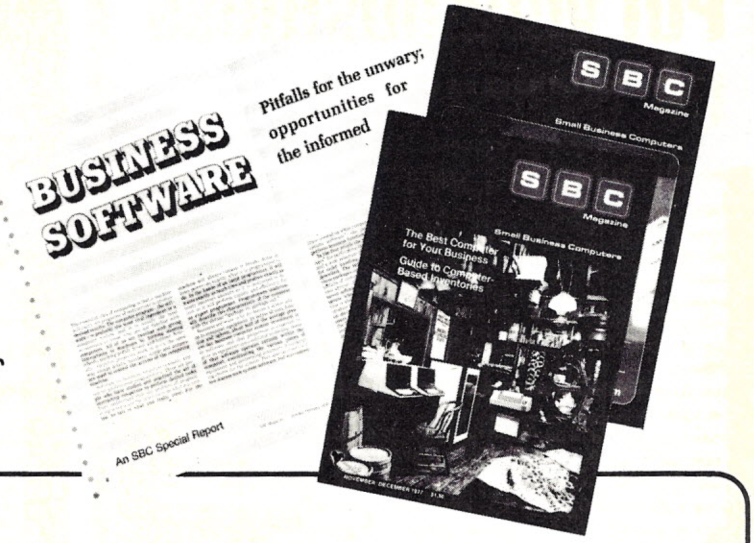

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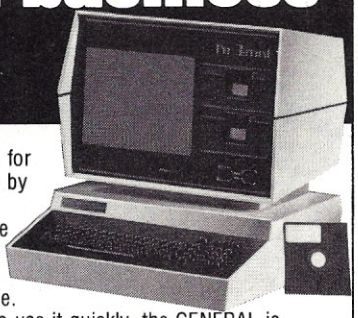

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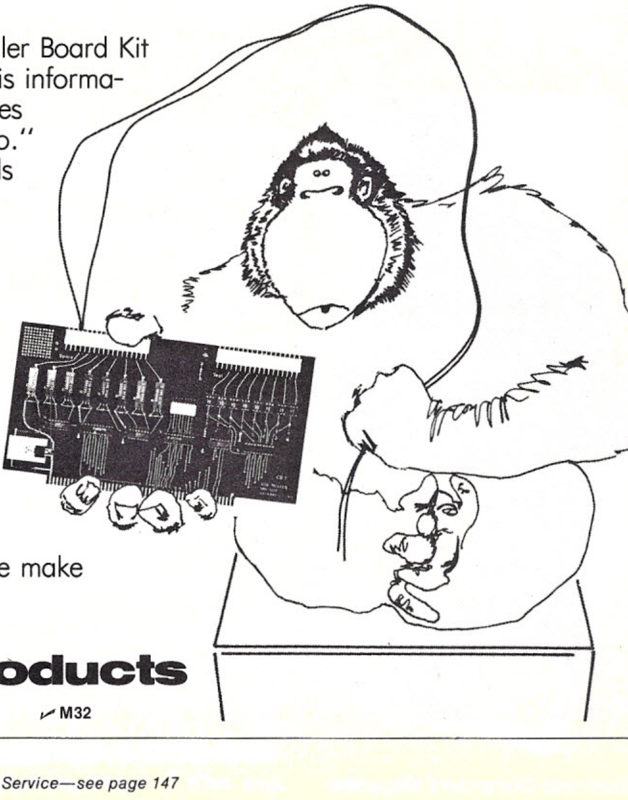

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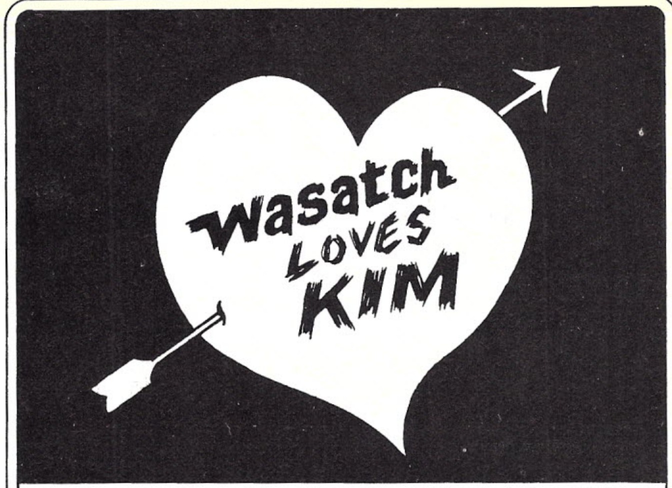

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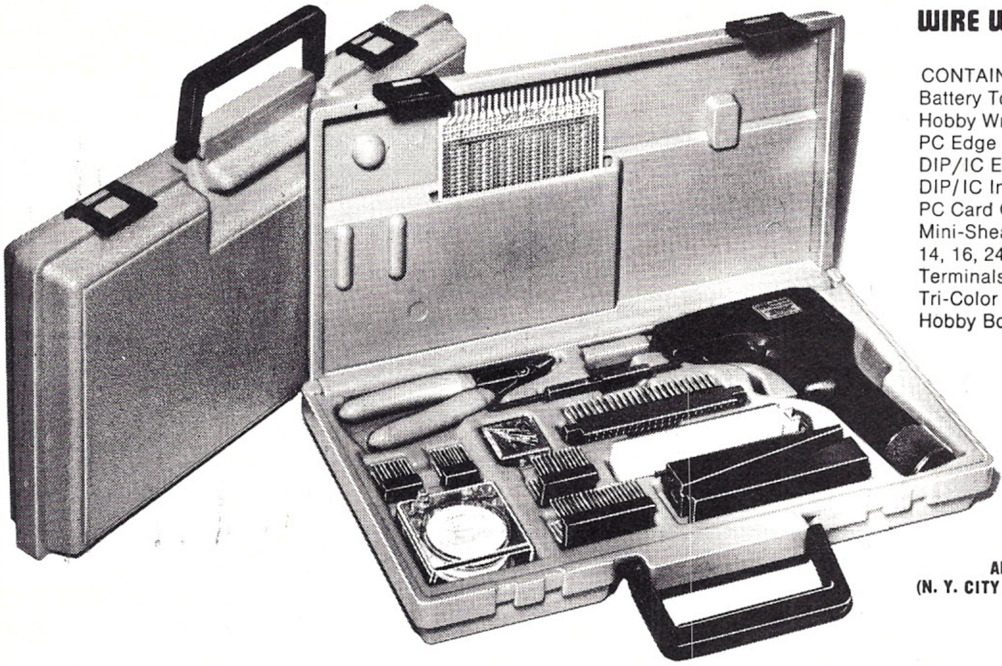

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TDL System Monitor Board, never used but built, sent for test, works perfect. Also includes 8K TDL BASIC, never used (no Z-80 CPU for Altair). Inc. manuals. Would cost $435. Will sell for $300 or best offer. R. Laprade, 43 Overlook Drive, Easthampton MA 01,27.

SOL 20 Software. Excellent applications in home finance, education, games, etc. Manual, cassette included. Low cost, guaranteed. Catalogue, $1. G. Newby, 299 Dawlish Ave., Toronto Ontario Canada M4N 1J6.

Apple II financial software by MIT Phd student w/cas and full doc. Option Anal; Bond Pricing I, II; Security Anal I, II, III; Cash Flow Anal I, II; Mortgage Anal. Requires FP, should run on PET/TRS-80. $15 each or all 9 for $50. Consider trade for soph soft (esp. hi-res games). Send cas. to Eric Rosenfeld, 70 Lancaster Rd., Arlington MA 02174. (617) 646-0827.

TRS-80 Pgms—Analyze utility expenses, $10. Option writing— determine profitable trades, $12. Math tutor—all levels, $12. Many others. Send for list. J. Fox, 27 Prince William Rd., Morganville NJ 07751.

TRS-80 programs written to your specifications. Very reasonable rates. I retain marketing rights. Send requirements for a prompt quote. J. Fox, 27 Prince William Rd., Morganville NJ 07751.

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TRS-80 Level II programs on cassette. 4K: Lunar/Martian Lander with 3 degrees of freedom ($8). 16K: Battle Klingons, Romulans with Star Trek ($10); you name teams in College/Pro Football ($12); shoot down attacking aircraft in Carrier Battle ($6). R. Fitzgerald, 3338 Sheila Lane #292, Dallas TX 75220.

Micropolis software special: Investment analysis package, $30; Home/family package, $30; Game package, $15; Assembly language prog. course for beginners, $30; Raw accts.-receivable program ready to personalize, $95. Order now. Phil Bell, 813 MacArthur Dr., Urbana IL 61801.

Heath H11 owners. For sale: 4K core memory: Use as small disk. 16K dual width Intel. $425 each, $700 for both. Ed Judge (413) 584-7159 anytime.

PET Owners. Send for free catalog of PET software. C.M. Stuart, 5115 Menefee Drive, Dallas TX 75227.

TRS-80 Program Trade: Would like to trade programs. Have about 25 cassettes of games, graphics, etc. Send yours on a C-60 cassette and I will record all I can on your cassette and return it to you. Level I only, have Level II on order. Jim Clayton, 3520 SE Vineyard Road, Milwaukie OR 97222.

New Pertec Attache 700, turnkey monitor board, video board, CPU board, full 64-character alphanumeric ASCII keyboard, weighs 25 pounds and is built around the 8080 MPU. Included is a 16 MCD RAM memory board. Sale price, $1,250. This is 1/2 the $2,500 retail value. Call or write: John H. Scheele, 515 West Shadylane, Barrington IL 60010. Office phone: (312) 467-3520; Home phone: (312) 382-2192.

Quality Apple II Software—cassette + doc. Disk-compatible catalog prog. (e.g., author-title index or disk prog. index) can fetch prog. names from D$CATALOG, $10; Auto Save/Restore disk to backup tape, $5; Graphic blackjack, paddle-input, auto-play mode, $10. Any 2/$15. All 3/$18. George W. Lee, 18803 S. Christina Ave., Cerritos CA 90701.

COSMAC Elf II: Giant board, 4K memory, 3A PS, Tiny BASIC, 3 Kluge boards, all manuals and books. All AOK. $225 ppd. A. Adams, 1533 Jasmine Ave., New Hyde Park NY 11040.

KIM-1, manuals, software, like new: $195. Kimsi with 5 S-100 slots and Kimsit power supply (both factory assembled). Great condition: $180. Al Wong, 90 SW 130th Ave., Beaverton OR 97005. (503) 249-4204.

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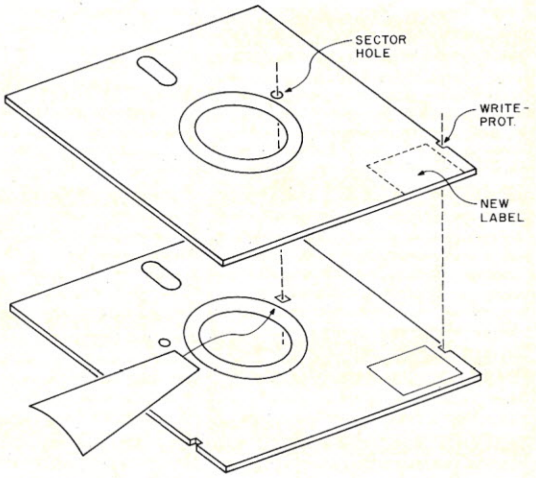
All right, all you spendthrifts (after plunkin' down for that disk drive, who isn't?). How would you like someone to give you a new diskette for each diskette you already have? OK. Just turn it over and record the other side.

How so? Simple: A few drives are designed to record both sides of your diskette; therefore, both sides have been prepared for recording. The opening for the head is already cut into the jacket. All you need are openings for the sector hole and the write-protect and a label on the back side of the jacket.

Refer to the illustration and *very carefully* perform the following steps (WARNING: No fingerprints on the recording surface. Do not scratch, cut, or in any way damage the recording surface. Do not leave any dirt, lint or other contamination on the recording surface or inside the jacket):

1. Align one diskette over another so that the head openings are to one end and sector holes are on opposite sides of the spindle holes. Center the upper disk sector hole in the jacket sector opening and *lightly* pencil the center location for a new hole on the lower diskette.
2. Turn both diskettes over and again mark the position of the new sector hole on the other side of the lower disk.
3. In a similar way, mark new write-protect notches on the lower diskette.
4. Use thin, tough, slick-surface material that will leave no lint (such as some file folders are made of) and cut a wedge about ¾ inch wide and four to six inches long. Do not use a hard material like plastic or metal.
5. Slip the wedge into the jacket, between the jacket and the disk. Use a single-edge razor blade or hobby knife to cut a 3/16 x 3/16 inch sector hole (square is as good as round) in the jacket. Use care not to cut, scratch or indent the medium. Repeat for the opposite side of the diskette.
6. Cut out the write-protect notch and place a label on the new face of the diskette.

Now, have twice as much fun as before.■



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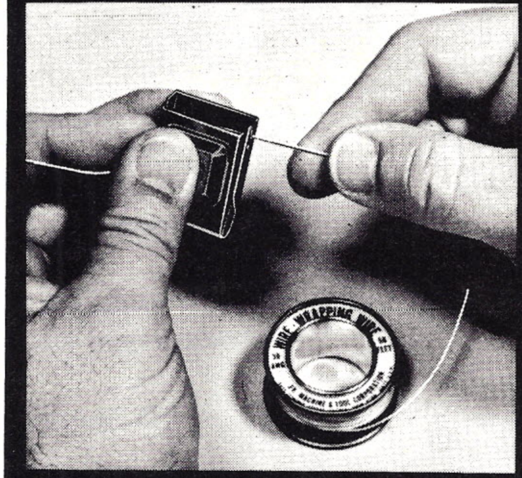

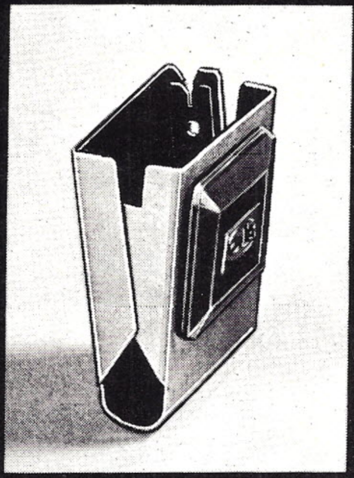

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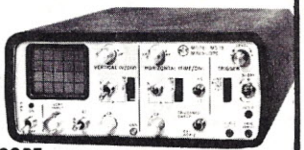

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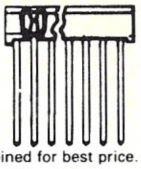

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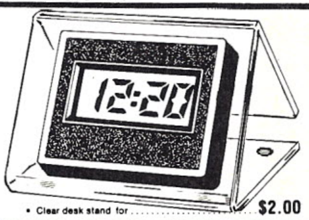

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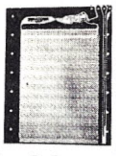

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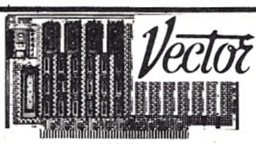

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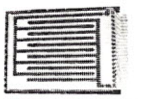

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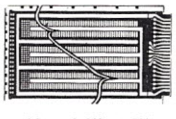

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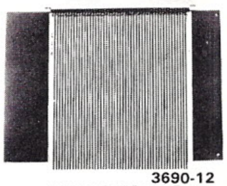

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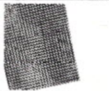

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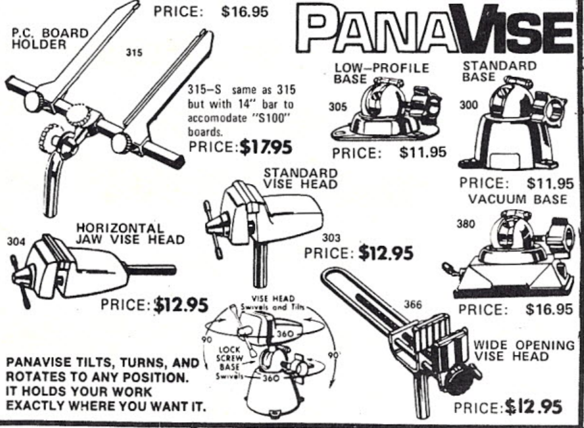

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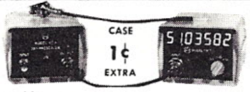

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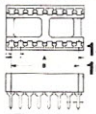

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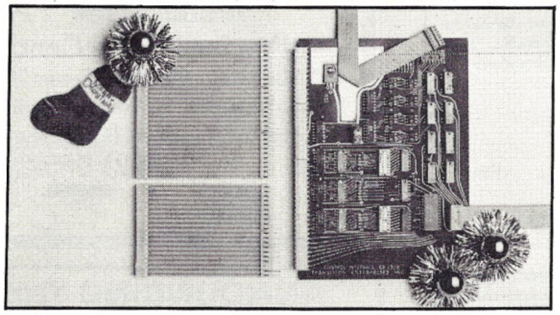

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```
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1F 1F 1F 1F CD 1F 01 F1 CD 1F 01 3E 20 18 04 E6
0F C6 30 C5 E5 5F 0E 02 CD 05 00 E1 C1 C9
```

```
          ORG     0100H
LBL000    EQU     0000H
LBL001    EQU     0002H
LBL002    EQU     0005H
LBL003    EQU     000AH
LBL004    EQU     000FH
LBL005    EQU     0020H
LBL006    EQU     0030H
LBL007    EQU     0080H
          LXI     H,LBL007
          MVI     B,LBL003
LBL008:   MOV     A,M
          CALL    LBL009
          INX     H
          DJNZ    LBL008
          JMP     LBL000
LBL009:   PUSH    PSW
          RAR
          RAR
          RAR
          RAR
          CALL    LBL010
          POP     PSW
          CALL    LBL010
          MVI     A,LBL005
          JMPR    LBL011
LBL010:   ANI     LBL004
          ADI     LBL006
LBL011:   PUSH    B
          PUSH    H
          MOV     E,A
          MVI     C,LBL001
          CALL    LBL002
          POP     H
          POP     B
          RET
LBL012:
          END
```

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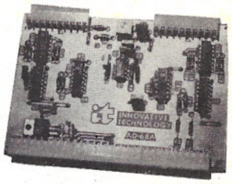

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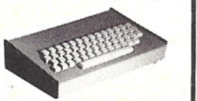

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In fact, not only will you be able to use a personal computer creatively, you'll also be able to read magazines such as BYTE . . . INTERFACE AGE . . . POPULAR ELECTRONICS and PERSONAL COMPUTING and *understand* the articles.

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Like all computers, ELF II understands only "machine language"—the language computers use to talk to each other. But, to make life easier for you, we've developed an **ELF II Tiny BASIC.** It talks to ELF II in machine language for you so that you can program ELF II with simple words that can be typed out on a keyboard such as PRINT, RUN and LOAD.

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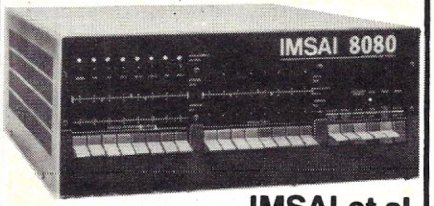

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Marinchip Systems M9900 CPU
The Complete, Compatible 16 bit CPU for the S-100 Bus

The Marinchip Systems M9900 CPU lets you move up from an 8 bit micro to a full 16 bit mini without giving up the unique choice and economy of the S-100 bus. When you choose the M9900 CPU, you buy not just a CPU board, but one of the most complete and flexible software systems available anywhere -- and it's included with the CPU at *no additional cost!*

The heart of the M9900 CPU is T.I.'s TMS9900, the most advanced single-chip computer available today. It is a complete minicomputer on a chip – with multiply and divide, 16 general registers, and all the instructions you expect on a mini. Marinchip Systems has interfaced the TMS9900 to the S-100 bus so you can use almost any memory or I/O device you now own or plan to add in the future. The M9900 CPU can also use 16 bit memories on the S-100 bus – even intermixed with normal S-100 memories: we pioneered 16 bit operation on the S-100 bus to bring you speed without obsoleting everything you own.

The power of a 16 bit computer is wasted unless the software brings it to the user. Marinchip Systems has designed and written the software for the M9900 CPU to be comprehensive, easy to learn, and flexible enough to grow to whatever your application demands. Included with every M9900 CPU are:

Disc Executive
A file-oriented operating system featuring automatic file allocation, program chaining, and support of all peripherals as files.

Text Editor
A text editor which features both context and line-oriented editing, character-by-character interactive editing, and automatic paging of large files to disc to eliminate limits due to memory size.

BASIC
BASIC includes file I/O, automatic selection of integer arithmetic when possible, and symbolic statement trace for debugging. A full set of string and mathematical functions is provided.

Word Processor
The Word Processor features right justification, centering, multiple column output, automatic page titles, footings, and assignment of section numbers. The Word Processor is designed to be easy to learn and use – often NO commands are required to produce a document.

Assembler
The Assembler generates relocatable code, and permits conditional assembly as well as complex expressions in source code.

Linker
The Linker permits large programs to be developed as small modules, then combined into a final program.

and more . . .

Also included are an instruction trace debug package, processor, memory, and file diagnostics, disc utility, floating point package, and more.

Plus . . .

Pascal
Marinchip Systems supplies a Pascal compiler for the M9900 CPU for $150. This Pascal permits large programs to be written and compiled, and allows Pascal programs to call others compiled separately.

META
The META compiler-writing language is available for the M9900 CPU for $100. This language makes development of compilers and macro processors simple and fast. Complete source code is supplied with this package to permit extension.

Marinchip Systems has put it all together -- a 16 bit CPU, the S-100 bus, and complete software that was designed together, not thrown together. And of course it comes with user manuals that are complete and easy to understand. The next step is yours: order the CPU and PROM/RAM/SIO boards and step up to 16 bit power, or order the documentation package and see for yourself that the M9900 CPU is your best choice.

	Kit	*Assembled*
M9900 CPU	$550	$770
PROM/RAM/S10	$275	$350
Pascal		$150
META		$100
Documentation only		$ 20

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16 St. Jude Road
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(415) 383-1545

NEW PRODUCTS

(from page 20)

size and shape can be displayed simultaneously, as well as real subscripts, superscripts and proportional spacing.

In short, the Visable Memory makes a versatile text display. With the graphing routines in the software package, many kinds of graphs and charts can be displayed.

Jumpers or an optional DIP switch select the 8K block of addresses to be assigned to the board. An optional jumper selectively disables the top or bottom half of the display, thus allowing 4K to be used for program storage without showing up as random patterns on the screen. The "Decode Enable" and "Vector Fetch" signals needed when the KIM is expanded beyond 4K are generated by the board and need simply be connected to the proper pins of the application connector. Up to three Visable Memory boards may be connected to the KIM without overloading the bus.

The board is designed to be mounted beneath the KIM-1. It is the same width as the KIM, and the 44-pin edge connector is in the same position as the KIM's expansion connector. Price is $289 assembled and tested.

Micro Technology Unlimited, PO Box 4596, 29 Mead Street, Manchester NH 03108.

8080/Z-80 Disassembler

"The Source" is an 8080/Z-80 disk-based disassembler developed by MJB Computer Associates, 41 Meadow Drive, Spencerport NY 14559. It will run on any 8080, 8085 or Z-80 microcomputer operating under CP/M.

Disassembly mnemonics are switch selectable for either TDL's Macro Assembler or the mnemonics for MAC by Digital Research. The source code produced by "The Source" can be directed to a printer or a disk file.

As a disk file it is ready to be assembled or edited. A coded cross-reference table is produced, and many switch-selectable options are available to aid in disassembly. All subroutines in the source file, as well as byte and word values, are labeled. The full Z-80 instruction set is supported; even destination addresses of relative jumps are labeled.

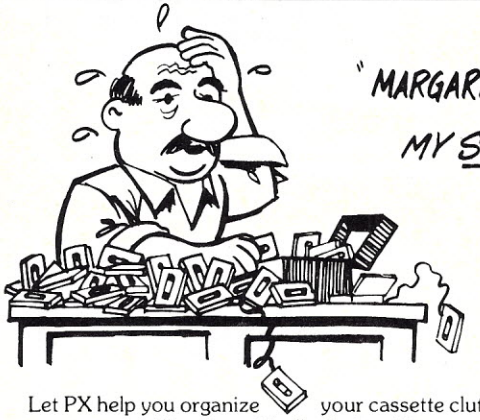
"The Source" is distributed on a single density 8-inch floppy disk. The price, including instructions, disassembly tips and examples, is $69.95.

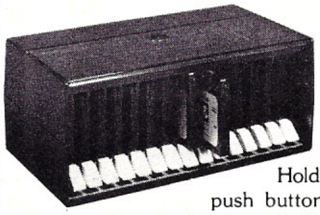
Questdata

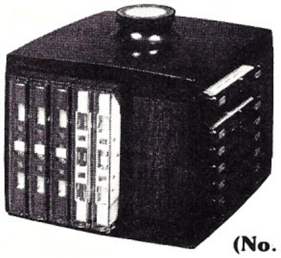
COSMAC Super Elf owners now have a magazine of their own. Quest Electronics has started a publication, called *Questdata,* which will be devoted entirely to information about the COSMAC Elf and other 1802 systems. The publication features interviews with Tom Pittman about his 1802 Tiny BASIC, machine-language experiments, video games and other topics for owners of this single board microcomputer which comes complete with graphics interface.

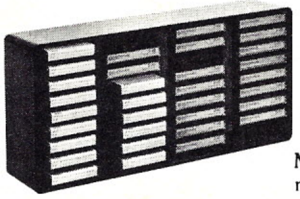
Since the Super Elf has many control applications and experimental possibilities, *Questdata* will attempt to show how this microcomputer can be used to do things around the home. For example, the first issue features a "Three Minute Telephone Timer." Not only will this program tell you when you are going to be talking overtime on long-distance calls, but it can also be used to time chess games, eggs cooking and sprinklers. Hooked to a relay the timer could be used to turn on coffee or TV at a given time. *Questdata* is published monthly and costs $12 a year.

Questdata, PO Box 4430, Santa Clara CA 95054.









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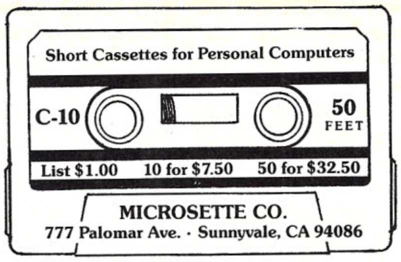
Due to the unpredictability of the electronics marketplace, prices are subject to change without notice.



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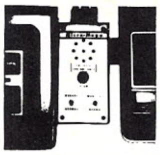

The Micro-Mega Cassette Control Unit does all this and more. You get instant manual control of the recorder at the flick of a switch. Want to find the beginning or end of a program? Flick another switch, and you'll hear it. All cables remain plugged in all the time.

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LM308N	.89
LM309H	1.15
LM309K	.95
LM311H/N	.90
LM317T/K	2.92
LM318	1.35
LM320K-5	1.20
LM323K-5	6.95
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.60
LM320T-8	1.60
LM320T-12	1.50
LM320T-15	1.60
LM324N	1.15
LM339N	1.55
LM340K-5	1.10
LM340K-8	1.10
LM340K-12	1.10
LM340K-15	1.10
LM340K-24	1.10
LM340T-5	1.10
LM340T-8	1.10
LM340T-12	1.10

LM340T-15	1.10
LM340T-18	1.10
LM340T-24	1.10
LM343H	4.50
LM370	1.15
LM377	4.50
LM379	5.00
LM380N	1.00
LM381	1.60
LM382	1.60
LM703H	.40
LM709H	.28
LM723H/N	.50
LM733N	.67
LM741CH	.35
LM741N	.25
LM747H/N	.62
LM748N	.35
LM1303N	.82
LM1304	1.10
LM1305	1.27
LM1307	2.00
LM1310	2.75
LM1458	.47
LM1800	1.75
LM1812	7.50
LM1889	3.00
LM2111	1.75
LM2902	1.50
LM3900N	.60
LM3905	1.75
LM3909N	.61
MC1458V	.50
NE540L	2.89
NE550N	.65
NE555V	.43
NE556A	.79
NE565A	1.00
NE566V	1.50
NE567V	1.20
NE570B	5.00
NE571B	5.00
78L05	.60
78L08	.60
79L05	.70
78M05	.85
75108	1.75
75491CN	.50
75492CN	.55
75494CN	.89
A to D CONVERTER	
8038	4.50
8700CJ	13.95
8701CN	22.00
8750CJ	13.95
LD130	9.95
9400CJV/F	7.40
ICL7103	9.50
ICL7107	14.25

CMOS	
CD34001	.50
CD4000	.16
CD4001	.21
CD4002	.21
CD4006	1.10
CD4007	.21
CD4008	.21
CD4009	.39
CD4010	.39
CD4011	.21
CD4012	.21
CD4013	.36
CD4014	.86
CD4015	.86
CD4016	.36
CD4017	.94
CD4018	.94
CD4019	.21
CD4020	1.02
CD4021	1.02
CD4022	.86
CD4023	.21
CD4024	.75
CD4025	.21
CD4026	1.51
CD4027	.36
CD4028	.79
CD4029	1.02
CD4030	.21
CD4035	1.02
CD4040	1.02
CD4042	.71
CD4043	.63
CD4044	.63
CD4046	1.67
CD4049	.36
CD4050	.36
CD4051	1.13
CD4060	1.42
CD4066	.71
CD4068	.40
CD4069	.40
CD4070	.40
CD4071	.21
CD4072	.21
CD4073	.21
CD4075	.21
CD4076	1.75
CD4078	.40
CD4081	.21
CD4082	.21
CD4116	.47
CD4490	5.50
CD4507	1.00
CD4508	4.25
CD4510	1.02

CD4511	.94
CD4515	2.52
CD4516	1.10
CD4518	1.02
CD4520	1.02
CD4527	1.51
CD4528	.79
CD4553	5.75
CD4566	2.25
CD4583	4.50
CD4585	1.10
CD40192	3.00
74C00	.28
74C04	.33
74C10	.28
74C14	2.10
74C20	.28
74C30	.28
74C48	1.95
74C74	.75
74C76	1.40
74C90	1.15
74C93	1.40
74C154	3.00
74C160	1.44
74C175	1.35
74C192	1.65
74C221	2.00
74C905	3.00
74C906	.75
74C914	1.95
74C922	5.50
74C923	5.50
74C925	6.95
74C926	6.95
74C927	6.95
INTERFACE	
8095	.65
8096	.65
8097	.65
8098	.65
8T09	1.25
8T10	4.50
8T13	3.00
8T20	5.50
8T23	3.10
8T24	3.50
8T25	3.20
8T26	1.69
8T28	2.75
8T97	1.69
8T98	1.69
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RAM	
2101-1	3.95
2102-1	.95
2102AL-4	1.60
21F02	1.25
2104A-4	4.95
2107B	4.95
2111-1	3.75
2112-2	3.95

2114	8.50
4116	17.95
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MM5262	.40
MM5280	3.00
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9368	3.50
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MM5309	3.00
MM5311	3.60
MM5312	4.80
MM5313	3.60
MM5314	3.90
MM5315	4.00
MM5316	5.00
MM5318	3.60
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7208	15.95
7209	4.95
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DS0056CN	3.75
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Solder Tin Low Profile

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8	.15	22	.30
14	.18	24	.35
16	.20	28	.42
18	.27	36	.58
20	.29	40	.57

3 level wire wrap gold.
14 pin .25 16 pin .27
2 level 14 pin ww .20

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6800	19.50
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CDP1802D	25.00
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6820	9.95
6850	12.95
6502	18.50
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AY5-1013	5.50
AY5-1014	7.50
3341	6.95
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1702A	3.95
N82S23	2.95
N82S123	3.50
N82S126	3.75
N82S129	3.75
N82S131	3.75
N82S136	8.75
N82S137	8.75
2708	10.60
DM8577	2.90
8223	2.90
2716T1	22.50
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44 pin edge	2.00
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100 pin edge WW	5.25
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1 MHz	4.50
2 MHz	4.50
4 MHz	4.25
5 MHz	4.25
10 MHz	4.25
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32768 Hz	4.00
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14.31818 MHz	4.25
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RESISTORS ¼ watt 5%
10 per type .03 1000 per type .012
25 per type .025 350 piece pack
100 per type .015 5 per type 6.75

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Fully assembled	72.50
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Red T018	.15
Green, Orange, Yellow T018	.20
Jumbo Red	.20
Green, Orange, Yellow Jumbo	.25
Cliplite LED Mounting Clips	8/$1.25

(specify red, amber, green, yellow, clear)

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Complete line of breadboard test equip.
MAX-100 8 digit Freq. Ctr. $128.95

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Batt. oper. General purpose or medical 32°–230°F. Disposable probe cover ±.2° accuracy. Comp. assy. in compact case.

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Additional Drive Kit	415.00

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MM5865 Stopwatch Timer	9.00
PC board	7.50
Switches Mom. Pushbutton	.27
3 pos. slide	.25
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Paratronics 100A Logic Analyzer Kit	**$224.00**
Model 10 Trigger Expander Kit	$229.00
Model 150 Bus Grabber Kit	$369.00
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12V CT 250 ma wall plug	3.50
24V CT 400 ma	3.95
10V 1.2 amp wall plug	4.85
18V 6 amp	12.95

DISPLAY LEDS			
MAN1	CA	.270	2.90
MAN3	CC	.125	.39
MAN72/74	CA/CA	.300	1.00
DL704	CC	.300	1.25
DL707/DL707R	CA	.300	1.00
DL727/728	CA/CC	.500	1.90
DL747/750	CA/CC	.600	1.95
DL750	CC	.600	1.95
FND359	CC	.357	.70
FND500/507	CC/CA	.500	1.35
FND503/510	CC/CA	.500	.90
FND800/807	CC/CA	.800	2.20
3 digit Bubble			.60
4 digit bubble			.80
DG8 Fluorescent			1.75
DG10 Fluorescent			1.75
5 digit 14 pin display			1.00
NSN69 9 digit display			.60
7520 Clairex photocells			.39
TIL311 Hex			9.50

IC Test Clips	1	10
Red	.55	.47
Black	.55	.47
Keyer 8043 comp. w/spec./sock.		14.50

Sinclair 3½ Digit Multimeter

Batt./AC oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee. Best value ever! **$59.95**

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Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instrucs. Green and orange displays also avail. **Same kit w/.80" displays. $21.95**

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Video computer with games and graphics.

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1978 IC Update Master Manual **$30.00** Complete IC data selector 2175 pg. Master reference guide. Over 42,000 cross references. Free update service through 1978. Domestic postage $3.50. Foreign $6.00.

New Cosmac Super "ELF"

RCA CMOS expandable to 64K microcomputer w/HEX keypad input and video output for graphics. Just turn on and start loading your program using the resident **monitor on ROM.** Pushbutton selection of all four CPU modes. LED indicators of current CPU mode and four CPU states. Single step op. for program debug. Built in pwr. supply, 256 Bytes of RAM, audio amp. & spkr. 100 pg. detailed assy. man. incl. new exten. software section. PC board solder masked & all parts fully socketed. Comp. Kit **$106.95.** High address display option **8.95**; Low address display option **9.95**; Custom hardwood cab.; drilled front panel **19.75**; Nicad Battery Backup Kit w/all parts **4.95**; Fully wired & tested in cabinet **151.70**; Questdata 1802 software club. 10–12 pg. monthly publication **12.00** per yr.

4K Elf Expansion Board Kit with Cassette I/F $79.95

Available on board options: 1K super ROM monitor **$19.95** Parallel I/O port **$7.95** RS232 I/F **$3.50** TTY 20 ma I/F **$1.95** S-100 Memory I/F **$4.50**

Tiny Basic for ANY 1802 System

Cassette **$10.00.** On ROM Monitor **$38.00.** Super Elf owners, 30% off. Object code listing or paper tape with manual **$5.50.**

Original ELF Kit Board $14.95

Video Modulator Kit $8.95

Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

60 Hz Crystal Time Base Kit $4.40

Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

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CT7015 direct drive chip displays date and time on .6" LEDS with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

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Complete kit less case **$37.50**

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Complete kit less case **$47.75**
Prescaler Kit to 350 MHz **$19.95**

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Ultraviolet, assembled **$49.95**

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Full six digit battery operated. 2–5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instruc.

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DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

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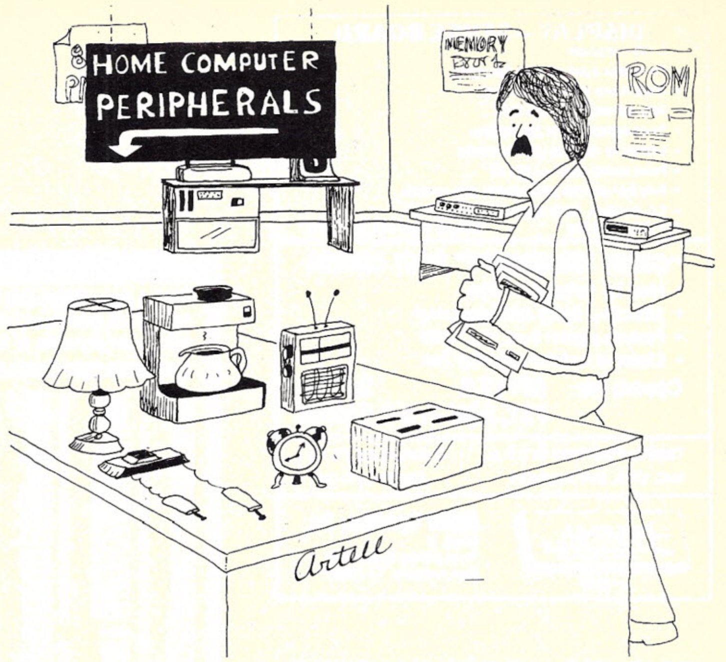

SOL-20 SOFTWARE

from ESV Computer Service

ProcessorTechnology

DIAGNOSTICS II: Checks user RAM (addresses are keyboard selectible by operator), video RAM, SOLOS or Bootload RAM, audio interface, and personality module. Features hard-copy printout of video displays using TAB key, and selectible output ports. Cassette tape comes with SOLOS version on one side & Bootload (BOOTL) on the other for use with either cassette or Helios SOL Systems .... $50. on cassette

DISASSEMBLER: Allows conversion of machine language programs to assembly language. Features operator selectible output ports for hard-copy printer or video display and audio cassette storage of disassembled text. Permits modification to be made for custom use or possible relocation. Symbol table may be anywhere in RAM and is assigned by the operator during initialization. Line numbers and labels are automatically assigned by the disassembler during construction of the assembly language program. Special characters will be displayed in the line number's most significant digit to flag the need to divide the machine code for 2 or more passes when the line number exceeds 9999. Tape storage (if selected) is done byte-by-byte (text) for use with assemblers other than ALS-8 or Software #1. .... $30. on cassette

MAILBOX: A mailing list program designed to work on your Helios Disk System. Features online editing for data entry, operator may select serial or parallel drivers (included on diskette) for hard copy, pre-sorted mailing labels (by zip codes as required by postal regulations for bulk mailing), label search, modification of single line should address or name need changes, file status check to determine amount and percentage of "dead space" and number of names in file, file compression to remove data in the same size file, generate separate diskette to increase data storage, will dump files to either 2 or 4 columns on printer, and is operator selectible .... $45. on Helios diskette

DROIDS: An action game where you play the computer. Try to escape Droids by hiding behind fences. Features static practice mode for skill development and real time attack mode with selectible difficulty factors .... $19.50 on cassette

ALS-8 UTILITIES adds cassette I/O operations to ALS-8. Included are seven custom tape commands and five clear memory. commands. Source program on cassette will assemble into 12C (hex) bytes.
EC-001 Source program on cassette tape **$15.00**

SOFTPAC #1 cassette uses Basic/5 on any Sol-20/SOLOS with 16K of RAM. Included are four games, STAR, BLACKJACK, CRAPS, and WAR.
EC-002 Basic/5 programs on cassette tape **$18.00**

BLOCKADE is an action game for two players on the same keyboard. Build a wall as you move and trap your opponent. Get sound effects through an AM radio or the Music System. Machine language program runs in 8K of RAM.
EC-003 Machine language program on cassette **$14.00**

SOL-20 DIAGNOSTIC checks user RAM, system RAM, SOLOS, keyboard, video, and cassette interface. This machine language program requires 8K of RAM.
EC-004 Machine language program on cassette **$45.00**

CALENDAR & TIME has a calendar for whatever month and year you want. Also included is a time program which displays hours, minutes, and seconds on the screen. These Basic/5 programs require 16K of RAM.
EC-005 Basic/5 programs on cassette tape **$10.00**

DIRECT REDUCTION LOAN provides amortization schedule for entire loan period or a single period of interest. Total interest paid is also calculated. 12K of RAM is required for this Basic/5 program.
EC-006 Basic/5 program on cassette tape **$10.00**

ACCOUNTS RECEIVABLE uses cassette data files to keep customer information on cassette tape. Functions include update, report, search, and enter new records. 20K of RAM and 2 cassette recorders are required to run this Extended Cassette Basic Program.
EC-007 Basic program on cassette tape **$25.00**

SMARTMOUTHED BLACKJACK uses Las Vegas rules including split hands, double down, and insurance bets. The humorous wise-cracks of the dealer keep the attention of the player for hours. This Extended Cassette Basic program requires 32K of RAM.
EC-008 Basic program on cassette tape **$19.50**

BIORHYTHM cassette produces complete plot or a simple list of critical days. Output can be directed to any pseudo port. Extended Cassette Basic version requires 24K. Basic/5 version requires 16K. Any number of days can be forecast.
EC-009 Basic/5 program on cassette tape **$19.50**
EC-010 Extended Cassette Basic program cassette .. **$19.50**

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CPU's cont.

8008	8.95
8035	19.95

RAM

7489	2.95
3101	3.95
8225	2.95
2101-1	2.95
2101-2	3.25
2101A-4	3.25
2102-2	1.50
2102L1	1.95
82S10	4.95
82S11	4.95
5101L-3	11.95
2107	3.95
TMS4060	3.95
UPD411	3.95
4200A	9.95
2114 200ns	13.50
2114 450ns	10.95
2114 650ns	6.25
4116 200ns	18.50
4116 300ns	17.50
4116 450ns	13.50

PROMS

8223	2.95
82S23	3.75
82S126	5.95
82S129	6.95
82S131	7.25
6306-1	6.95
93427	5.95
D3604	11.95
2616	50.00
1702A	4.95
2708	12.95
2716-5V	46.95

CHARACTER GENERATORS

2513 UC	7.95
2513 LC	7.95
2516	7.95
5240	7.95
MM6571A	9.95

KEYBOARD ENCODER

AY5-2376	14.95

UARTS

AY5-1012	8.95
AY5-1013	8.95
TR-1602	9.95
TMS6011	8.95

FIFO's

3341	7.95
1502E	10.95

PROG. LOGIC ARRAYS

82S100	11.95
82S101	11.95

SHIFT REGISTERS

C1402A	1.95
MM1403AH	1.95
MM5006AH	2.95
MM5060	3.95

CLOCK CHIPS

MM5311	7.95
MM5312	4.95
MM5313	7.95
MM5314	4.95
MM5315	7.95
MM5316	4.50
MM5375	5.95
TMS3834	6.95
CT7001	6.50

CALCULATOR CHIPS

MM5725	1.95
MM5736	1.95
MM5738	1.95
MM5739	1.95
MCS2521	1.95

INTERFACE CHIPS

DS0026	3.25
DS3608	3.85
DM8093	.95
DM8094	.95
DM8095	.95
DM8096	.95
DM8097	.95
DM8098	.95
DM8131	3.25
DM8202	1.45
DM8233	1.10
DM8234	1.10
DM8241	.45
DM8242	.45
DM8250	.90
DM8251	.90
DM8266	1.35
DM8267	1.35
DM8271	1.35
DM8544	1.30
DM8831	2.95
DM8833	2.60
DM8835	2.60
DM8836	4.75
DM8837	2.45
74273	2.60
74390	2.10
81LS95	1.95
81LS96	1.95
81LS97	1.95

S-100 MOTHER BOARD — 8 Slot Kit		69.00
S-100 32K STATIC MEMORY BOARD		
ALL BURNED IN	650ns	599.00
AND TESTED	450ns	735.00
ultra low power	200ns	875.00
S-100 EDGE CARD CONNECTORS		3.50
MAXI KEYBOARD — 53 Keys		19.95
MAXI KEYBOARD — 74 Keys		33.95
KEYPAD — 16 key	x-y matrixed	1.95
KEYPAD — 20 key	x-y matrixed	2.95
WIRE WRAP POSTS		
2 level 100/3.95	4 level	100/4.95
WIRE WRAP SOCKET PIN		100/7.95
TAPE READER — 12 level — includes both IR sources and pickups		29.00
MAKE YOUR OWN PAPER TAPE READER		
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REED RELAY — TTL compatible		1.89
SOLID STATE RELAY — micro reed actuated for total isolation		3.95
CRYSTAL FILTERS — 455 Kc miniature		
single section 1.95		dual section 2.95

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GLASS BEAD — 1%	15000 OHM	2.95
GLASS BEAD — 1%	200 OHM	2.95
CYLINDRICAL — .01%		3.95
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D/A CONVERTER — NE5008 (8 bit)	7.95
D/A CONVERTER — DAC-01-SH (6 bit)	6.95
PHOTO DIODE — super fast 0.5ns	3.95
IR DETECTOR — super sensitive	4.95

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LED .17"-3 dig. 1.25 — 6 dig. 3.95 — 8 dig. 4.95

PHOTO DEVICES—DIODES, XSTR's, DARLINGTONS

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H-38 - 3.25	MRD-250 - 1.95	LASCR-1.95

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2SC1358	100W-1400V-5A	TO-3	7.95
BUY69B	110W- 800V-10A	TO-3	5.95
W905	100W- 500V-5A	Plastic	4.95
362-4	20W- 500V-1A	Plastic	2.25
338-7	20W- 350V-1A	Plastic	1.50

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UNMARKED	1500V at 1 AMP	10/1.99
EG 250	2500V at .35 AMP	.95
HV60EL	6000V at 25 ma	1.95
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CARBIDE DRILL BITS AND ROUTER BITS
for P.C. board work — *MIXED SIZES*

OUR MIX — DRILLS	10/12.95	100/95.00
OUR MIX — ROUTERS	10/15.95	100/125.00

RADIO SHACK® TRS-80™ COMPUTER SERVICE AND MODIFICATION

BE FIRST TO TURN YOUR TRS-80 INTO A SUPER MACHINE

CHRISTMAS SPECIAL 5% OFF

1. Keyboard and Video Mod

ADD RAM FOR LOWER CASE CHARACTERS AND CLEAN UP HORIZONTAL SMEAR (SEND YOUR TRS-80 MICROCOMPUTER ONLY)

PARTS AND LABOR $59.00

2. Install 16K Memory

JUST SEND US YOUR TRS-80 MICROCOMPUTER AND WE DO THE REST.

16K OF MEMORY AND LABOR $189.00

3. Level 2 plus 1 Mod

WE INSTALL *YOUR* LEVEL 2 SO YOU KEEP LEVEL 1 AND CAN USE IT BY JUST FLIPPING A SWITCH. (SEND LEVEL 2 WITH YOUR TRS-80)

$69.00

4. Clock Mod

INCREASE YOUR PROCESSING SPEED BY 30%. WITH THIS OPTION YOU CAN SWITCH-SELECT BETWEEN THE FASTER 2.66MHZ CLOCK RATE AND 1.77MHZ.

INSTALLATION, PARTS AND LABOR $49.00

5. Serial Printer Interface Mod

OPERATE CRYSTAL CONTROLLED TTY WITH LEVEL 1 OR 2. WE INSTALL SWITCH SELECTABLE BAUD RATES OF 75, 110, 137.5, 150, 300, 600, 1200, 2400, 4800, 9600 OR EXTERNAL. EIA RS232 AND CURRENT LOOP OUTPUT.

PARTS AND LABOR $119.00

6. Mini Floppy Mod

YOU PROVIDE EXPANSION INTERFACE AND WE'LL INSTALL A PERTEC F D 200 MINI FLOPPY.

PARTS AND LABOR (PERTEC F D 200 MINI FLOPPY INCLUDED) FOR ONLY $425.00

SPECIALS!! DO MORE THAN ONE MOD AND SAVE

MODS 1, 2, 3, 4 AND 5	$449.00
MODS 1 AND 2	$234.00
MODS 2 AND 3	$243.00
16K MEMORY, PARTS AND INSTALLATION DATA	$159.00

ALL WORK GUARANTEED UNCONDITIONALLY FOR 1 YEAR

SEND TRS-80 KEYBOARD ONLY!!

RETURN SHIPPING:
FROM ENGLAND ADD $30.00 FOR AIR, $9.50 SURFACE MAIL
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REPAIR—*WE WILL REPAIR ANY ORIGINAL TRS-80 MICROCOMPUTER OR ONE OF OUR MODIFICATIONS.*

ALL PARTS AND LABOR *$69.00*

NOTE: THIS IS AN INDEPENDENT SERVICE EFFORT NOT AFFILIATED WITH RADIO SHACK® OR TANDY CORPORATION.

TERMS FOR TRS-80 WORK: WE ACCEPT ONLY TRS-80 MICROCOMPUTERS! SHIP YOUR TRS-80 MICROCOMPUTER TO US, INSURED AND SUITABLY PACKAGED AND WE WILL RETURN SAME FREIGHT COLLECT. ALL FACTORY SEALS MUST BE INTACT. ANY UNIT WHOSE SEALS HAVE BEEN TAMPERED WITH WILL BE SHIPPED BACK IMMEDIATELY. MODS 1, 2, 4 AND 5 SEND TRS-80 MICROCOMPUTER ONLY. MOD 3 SEND YOUR TRS-80 MICROCOMPUTER AND LEVEL 2. MOD 6 SEND TRS-80 AND EXPANSION INTERFACE. **NORMAL TURN AROUND TIME IS UNDER 10 DAYS WITH CERTIFIED FUNDS**

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ALL ITEMS SUBJECT TO PRIOR SALE

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

New!

16K E-PROM CARD

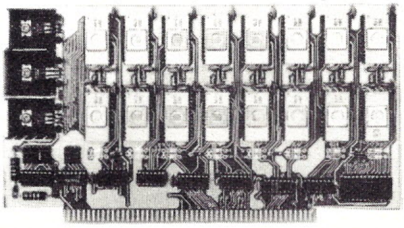
IMAGINE HAVING 16K OF SOFTWARE ON LINE AT ALL TIME!

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Double sided PC board with solder mask and silk screen and gold plated contact fingers.
2. Selectable wait states.
3. All address lines & data lines buffered!
4. All sockets included.
5. On card regulators.

KIT INCLUDES ALL PARTS AND SOCKETS (except 2708's). Add $25. for assembled and tested.



PRICE CUT!

$57.50 kit

WAS $69.95

SPECIAL OFFER:

Our 2708's (450NS) are when purchased with above kit. $8.95

Fully Static!

8K LOW POWER RAM KIT-$149.00

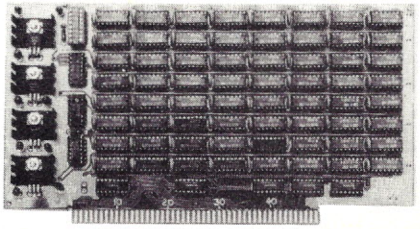
ADD $20 FOR 250NS

S-100 (Imsai/Altair) Buss Compatible!

KIT FEATURES:

1. Doubled sided PC Board with solder mask and silk screen layout. Gold plated contact fingers.
2. All sockets included.
3. Fully buffered on all address and data lines.
4. Phantom is jumper selectable to pin 67.
5. FOUR 7805 regulators are provided on card.

(450NS)



USES 21L02 RAM'S!

2 KITS FOR $279

Fully Assembled & Burned In
$179.00
Blank PC Board w/ Documentation
$29.95
Low Profile Socket Set 13.50
Support IC's (TTL & Regulators)
$9.75
Bypass CAP's (Disc & Tantalums)
$4.50

MOTOROLA QUAD OP - AMP
MC 3401. PIN FOR PIN SUB.
FOR POPULAR LM 3900.
3 FOR $1

ALARM CLOCK CHIP
N.S. MM5375AA. Six Digits.
With full Data. **New!**
$2.49 each

FULL WAVE BRIDGE
4 AMP. 200 PIV.
69¢ 10 FOR $5.75

NOT ASSOCIATED WITH DIGITAL RESEARCH OF CALIFORNIA, THE SUPPLIERS OF CPM SOFTWARE.

MOTOROLA 7805R VOLTAGE REGULATOR
Same as standard 7805 except 750 MA output.
TO—220. 5VDC output.
44c each or 10 for $3.95

450 NS! 2708 EPROMS
Now full speed! Prime new units from a major U.S. Mfg. 450 N.S. Access time. 1K x 8. Equiv. to 4-1702 A's in one package.
~~$15.75 ea.~~ **$9.95** ~~4 FOR $50.00~~
PRICE CUT

16K STATIC RAM KIT

OUR LATEST COMPUTER KIT! FULLY S-100 COMPATIBLE! FULLY STATIC, AT DYNAMIC PRICES!

WHY THE 2114 RAM CHIP?

We feel the 2114 will be the next industry standard RAM chip (like the 2102 was). This means price, availability, and quality will all be good! Next, the 2114 is FULLY STATIC! We feel this is the **ONLY** way to go on the S-100 Buss! We've all heard the HORROR stories about some Dynamic Ram Boards having trouble with DMA and FLOPPY DISC DRIVES. Who needs these kinds of problems? And finally, even among other 4K Static RAM's the 2114 stands out! Not all 4K static Rams are created equal! Some of the other 4K's have **clocked** chip enable lines and various timing windows **just as critical** as Dynamic RAM's. Some of our competitor's 16K boards use these "tricky" devices. But not us! The 2114 is the ONLY logical choice for a trouble-free, straightforward design.

BRAND NEW!

$359.00 COMPLETE KIT

SPECIAL INTRODUCTORY OFFER!
Buy 2 KITS (32K) for $650
450 NS

Blank PC Board with Documentation
$33.00

LOW PROFILE SOCKET SET – $12.00

ASSEMBLED & TESTED – ADD $30.00

2114's 4K RAM's – 8 FOR $69.95

KIT FEATURES:

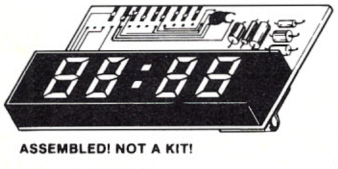
1. Addressable as four separate 4K Blocks.
2. ON BOARD BANK SELECT circuitry. (Cromemco Standard!), Allows up to 512K on line!
3. Uses 2114 (450NS) 4K Static Rams.
4. ON BOARD SELECTABLE WAIT STATES.
5. Double sided PC Board, with solder mask and silk screened layout. Gold plated contact fingers.
6. All address and data lines fully buffered.
7. Kit includes ALL parts and sockets.
8. PHANTOM is jumpered to PIN 67.
9. LOW POWER: under 2 amps TYPICAL from the +8 Volt Buss.
10. Blank PC Board can be populated as any multiple of 4K.

SUPER SPECIAL: BUY 32 KITS (512 KILOBYTES) (8-64K BANKS) for $9,995.00

NATIONAL SEMICONDUCTOR

JUMBO CLOCK MODULE

MA1008A BRAND NEW!



$6.95

2 FOR $13

(AC XFMR $1.95)

FEATURES:
- ★ FOUR JUMBO ½ INCH LED DISPLAYS
- ★ 12 HR REAL TIME FORMAT
- ★ 24 HR ALARM SIGNAL OUTPUT
- ★ 50 OR 60 Hz OPERATION
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- ★ SLEEP & SNOOZE TIMERS
- ★ DIRECT LED DRIVE (LOW RFI)
- ★ COMES WITH FULL DATA

ASSEMBLED! NOT A KIT!

ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock
#MA1008D — $9.95

PERFECT FOR USE WITH A TIMEBASE.

COMPARE AT UP TO TWICE OUR PRICE!

MANUFACTURER'S CLOSEOUT!

SALE!
1N4148 DIODES. SILICON.
Same as 1N914. New,
factory prime, Full Leads.
100 FOR $2
1000 FOR $17.50

New! REAL TIME Computer Clock Chip
N.S. MM5313. Features BOTH 7 segment and BCD outputs. 28 Pin DIP. **$4.95 with Data**

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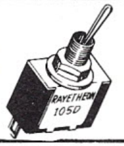

SPDT. By RAYTHEON. MADE IN USA! WITH HDWR.

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6 FOR $5

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S100 PRODUCTS

LOGOS I 8K STATIC RAM

- ★ Low Power
- ★ Selectable Memory Protect
- ★ Totally Buffered
- ★ Battery Back-up
- ★ Address on 1K boundary

ASSEMBLED		KIT	
250ns.	199.95	250ns.	149.95
450ns.	179.95	450ns.	125.95

Bare PC Board w/Data **$21.95**

Now over 1 year successful field experience

"Special Offer" Buy (4) 8K 450ns. Kits $117.00 ea.

EXIDY SORCERER

Complete expandable Z-80 based computer.
w/8K $8.95 (4-6 weeks)
w/16K $11.50 stock w/32K $13.95 stock
S-100 Expansion module.................$299.00

SPECIAL KEYBOARD BUY WHILE THEY LAST

"Clare Pender 63 Key ASCII
w/26 Pin & 34 Pin Output Conn." $54.95

IMS STATIC RAM BOARDS

★ Memory Mapping ★ Low Power
★ Phantom ★ 250 ns. or 450 ns.
Only available assembled & tested

	250 ns.	450 ns.
8K Static	$209.00	$189.00
16K Static	$449.00	$399.00
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EXPANDORAM MEMORY KITS

★ Bank Selectable ★ Uses 4115 or 4116 200 ns.
★ Write Protect ★ Power 8VDC, ±16VDC
★ Phantom ★ Lowest Cost/Bit

Expando 32 Kit (4115)		Expando 64 Kit (4116)	
8K	$149.95	16K	$245.95
16K	$239.95	32K	$469.95
24K	$325.00	48K	$675.00
32K	$400.00	64K	$869.95

PARATRONICS LOGIC ANALYZER KIT

MODEL 100A $219.95
(analyzes any type of digital system)
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Baseplate.............................9.95
Model 10 Manual......................4.95
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★ Telephone/TWX ★ S-100 compatible
★ Bell 103 freq. ★ Originate & answer mode
Assembled & Tested $279.95

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★ On board 2708 ★ 2708 included (450ns.)
★ Power on jump ★ completely socketed
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Kit $129.95
Bare PC Board .... $ 34.95
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★ Individual Prom Address
★ Uses Low cost 16K TI EPROMS
★ Optional 1K RAM ★ Phantom-control
Assembled and Tested 174.95
Kit 99.50

Hi PLOT LOW COST DIGITAL PLOTTER

★ RS 232
★ Plot Size 7" x 10"
★ Digitizer Avail. Soon
★ High Resolution
★ 2.4"/sec Plot Speed

NEW
List: $1085.00
OUR PRICE $999.00

BYTE USER 8K EPROM BOARD

★ Power on Jump ★ Reset Jump
Assembled & Tested 94.95
Kit 64.95
Bare Pc Board 21.95
Special Offer: Buy 4 kits only $59.95 each
NOTE: 2708-6 only $5.95

TARBELL FLOPPY INTERFACE

★ S100 Compatible ★ Uses CPM
★ Jumper Selectable ★ Persci,Shugart,etc
Assembled and tested $269.95
Kit $179.95
Bare PC Board .... $ 39.95
NOTE: For CPM Add $70.00
Documentation Add $20.00
★ Cassette I/O Kit only............$115.00

TRS 80 16K-UPGRADE KIT

★ 16K with Jumpers & Instructions for either Level I or Level II $119.95
★ 16K for Apple II Upgrade $117.95

PET TO S-100 ADAPTER

Allows Pet to be interfaced to popular S-100 Bus.
Kit $189.95
Assembled $269.95
For Low Cost 8 Slot Bus to expand your Pet only..................$149.95 Kit

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AM9511 Arith. Processor	$195.00
AM9517 DMA Controller	71.95
AM9519 Universal Interrupt	24.95
3881 (Z80 PIO)	10.45
3881-4 (4MHz)	14.95
3882 (Z-80 CTC)	10.45
3882-4 (4MHz)	14.95
8205/74S138 Decoder	2.95
8212 8 bit I/O	2.50
8214 Priority Int.	6.95
8216 Bus Driver	2.50
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8226 Bus Driver	3.95
8T26 Bus Driver	2.39
8228 Sys. Control	6.95
8238 Sys. Cont.	6.95
8251 Prog. I/O	11.50
8253 Int. Timer	19.50
8255 Prog. I/O	11.50
8257 Prog. DMA	19.50
8259 Prog. Int.	19.50
8275 CRT Controller	74.95
8279 Prog. Keyboard	19.95
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6820 PIA	7.20
6821 PIA	7.25
6828 Priority Int.	11.95
6834-1 512 x 8 Eprom	12.95
6850 ACIA	7.20
6852 Serial Adapter	9.95
6845/HD46505 CRT Contr.	39.95
6860 Modem	14.50
6862 Modulator	14.50
6871A 1.0MHz OSC	25.95
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2350 USRT	9.95
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1822 SCD 256 x 4 RAM	16.95
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1852 CD 8 bit I/O	10.95
1856 CD I/O	8.95
1857 CD I/O	8.95
6520 PIA	7.50
6522 Mult.	9.95
6530-002	15.50
6530-003	15.50
6530-004	15.50
6530-005	15.50
3851 F8 Prog. Store	14.95
3853 F8 Memory I/O	14.95

PROMS

2708	9.95
2708-6	5.95
1702A	3.95
1702A-6	3.50
2716-5V	44.95
2716-5V, 12V	24.95
2758 5V	25.95
5203AQ	11.95
5204AQ	9.95
6834-1	12.95
IM 5610	2.95
82S123	2.95
82S126	4.50
82S129	4.95

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4116 16K x 1	14.95
4115 8K x 1	6.95
4050 4K x 1	4.45
4060 4K x 1	4.45
4096 4K x 1	4.25
2104 4K x 1	4.95
2107B-4 4K x 1	4.25
5261	1.95
5262	1.95
5270	4.95
5280	4.95
1103	1.95
4008L	4.95
TMS4070 16K x 1	19.95
4027-3	4.95
MCM6605 4K x 1	7.95
6002	1.50

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1771-01 8" & Minifloppy	27.95
uPd372 Nec Floppy	49.95
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RO32513-001 (5V) Upper	9.50
RO32513-005 (5V) Lower	10.95
RO32513-ADM3 (5V) Lower	14.95
MCM6571	10.75
MCM6571A	10.75
MCM6574	14.50
MCM6575	14.50

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

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TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	5.50
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	9.95
IM6403	9.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	**9.95**

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MC14411	11.25
4702	14.95
WD1941	9.95

TV CHIPS

MM5320 TV Synch	7.95
MM5369 Prescaler	3.95
LM1889 Modulator	3.95
CW300 Saw Function	1.50
MM57100 Color TV Game	6.95
MM57104 Clock	3.75
AY38500-1 TV Game	5.95
AY38600 Color TV Game	24.95
AY38615-1 Color Converter	8.95
AY38700-1 Tank Chip	29.95
RF Modulator with Audio	8.95

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8700	8 bit Binary	13.50
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8038	Multifunction	3.95
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20 Pin W/W	.90	20 Pin S/T	.34
22 Pin W/W	.93	22 Pin S/T	.35
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• Microchess (cassette)	16.95
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16K CCD - First time offered Fairchild 460 CCD 16K Memory (now you can experiment with CCD technology at a reasonable price. 17 page Application note supplied with each order. Quantity limited)

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FND 503/510 CC/CA .500	.95
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Bowmar 9 digit bubble	.99
FSC 8024 4 digit CC .800	4.95
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Soroc IQ 120	895.00	945.00
Teletype Model 43	1199.00	1230.00
AM100	Contact sales desk	
Imsai w/22 slots	599.00	617.00
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Pennywhistle Modem	129.95	129.95
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★ Motorola Compatible Modules*

MEK 6800 D2 Kit	$235.00
9600 6800 MPU Module	495.00
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9602 16 slot Card Cage	75.00
9603 8 slot Mother Bd.	99.00
9604 System Power Supply	250.00
9610 Prototype Board	36.00
9615 4KEprom Module	250.00
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9626K 8K Static RAM Kit	225.00
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9640 Multiple Tuner Prog.	395.00
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Mot 43/86 Connectors w/w or s/t	5.95
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AMI EVK 200 Kit	249.95
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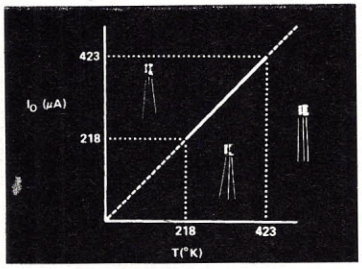
ANALOG DEVICES

Two-Terminal IC Temperature Transducer



Two terminal I.C. Temperature Transducer
ANALOG DEVICES AD590J is a two terminal device producing an output current proportional to absolute temperature. Laser triming produces ± 9°C maximum error without external calibration. Calibration can reduce maximum error to only ± 2°C over -55° to +150°C range. Sensitivity is 1uA/°K. Use with +4 to +30V supply as input to digital meter in thermometer applications. Excellent for remote applications due to the very high impedance. Comes in TO-52 metal can.

AD590J	$3.49
Specs and Application sheets	.80

QUIET FANS
Brand new 4" fans rated at 220V 60 cycle. When operated on 115V they run slower and almost noiselessly, just right for office equipment, TV sets or wherever low noise level is needed.

SPF-78409 .... $8.50

INTEGRATED TONE RECEIVER

MK5102(N)-5

FEATURES

- ☐ Detects all 16 standard DTMF digits
- ☐ Requires minimum external parts count for minimum system cost
- ☐ Uses inexpensive 3.579545 MHz crystal for reference
- ☐ Digital counter detection with period averaging insures minimum false response
- ☐ 16-pin package for high system density
- ☐ Single supply 5 Volts ± 10%
- ☐ Output in either 4-bit binary code or dual 2-bit row/column code
- ☐ Latched outputs

DESCRIPTION

The MK5102 is a monolithic integrated circuit fabricated using the complementary-symmetry MOS (CMOS) process. Using an inexpensive 3.579545 MHz television colorburst crystal for reference, the MK5102 detects and decodes the 8 standard DTMF frequencies used in telephone dialing. The requirement of only a single supply and its construction in a 16-pin package make the MK5102 ideal for applications requiring minimum size and external parts count.

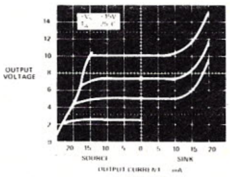
DETECTION FREQUENCY

Low Group f_o	High Group f_o
Row 1 = 697 Hz	Column 1 = 1209 Hz
Row 2 = 770 Hz	Column 2 = 1336 Hz
Row 3 = 852 Hz	Column 3 = 1477 Hz
Row 4 = 941 Hz	Column 4 = 1633 Hz

MK5102N-5	$34.95
Specs	.50
600 Ohm to 600 Ohm C.T. transformer	$1.95
Colorburst crystal for above	$1.75

ANALOG DEVICES

Pin Programmable Precision Voltage Reference



AD584 Output Voltage vs. Sink and Source Current

Pin Programmable Precision Voltage Reference
ANALOG DEVICES AD584JH offers pin-programmable selection of four popular output voltages: 10.000V, 7.500V, 5.000V and 2.500V. Laser trimming results in the most flexible monolithic precision reference available. Strobe input allows unit to "turn off" for use in power supply control. Output can sink or source current to greater than 10mA!
Maximum error over full temp range (0-70°c) is ± 30mV. Perfect for use in A-D converters, power supplies, calibrators, etc. 8 pin TO-5 metal can package.

AD584JH	$6.95
Spec and Data Sheets	.60

78P05SC 5V 10A TO-3 Reg	$12.95
21L02-4 (MM2102AN-4L 450nS)	$ 1.44
Z80CPU I.C.	$20.00
Z80ACPU I.C.	$28.00
Z80CTC I.C.	$11.00
Z80ACTC I.C.	$16.00
Z80PIO I.C.	$11.00
Z80APIO I.C.	$16.00
25 Pin RS-232 connector Male	$ 2.19
25 Pin RS-232 connector Female	$ 3.19
DB-51226 Hood for RS-232 connector	$ 1.39
D-20418 Screw Lock assembly	$ 1.19
4801 4KX1 Static RAM	$8.95, 8/ $60.00
4804 1KX4 Static RAM	$8.95, 8/ $60.00
MK5102 (N)-5 Touch Tone Receiver I.C.	$34.95
600ohm to 600ohm C.T. Xfmr	$ 1.95
3.579545 Color Burst Xtal	$ 1.75
uDP416 16K Dynamic RAM (200nS)	8/ $144.00
uDP416 16K Dynamic RAM (300nS)	8/ $128.00
6502 uProcessor	$10.95
LM13080N ½ Amp OP-AMP	$ 1.94
T.I. S-100 connector (IMSAI) solder	$3.59, 10/ $32.00
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8 bit D.I.P. Rocker switches	$ 2.15
MC1413P (ULN2003A) Hex Darlington	$ 1.59
THM-6073B TO-220 Heat Sink	5/ $ 1.00
MC14411P Baud Rate generator	$11.98
1.843 Crystal for MC14411	$ 4.95
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CA3130E Bi MOS OP Amp	$ 1.27
CA3140E Bi MOS OP Amp	$ .50
40673 Popular dual gate FET	$ 1.01
MM5865N Universal Timer I.C.	$ 9.75
CSC 500 MHz prescaler	$59.95
B and K 2800 3½ Digit DVM	$99.95
B and K Dual Tracer Scope Model 1432 (FOB Phoenix)	$750.00

POWER OP AMP
250mA output current capability. Operates on as low as 3V. Input parameters are programmable for system optimizing. Electronic shut down allows output to float. Packaged in 8 pin mini-dip.

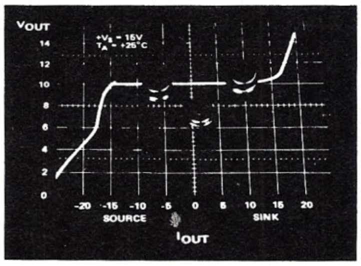
LM13080N	$1.94
Specs and applications	.60

TRI-TEK

T1

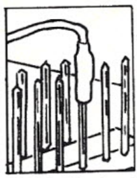
ANALOG DEVICES

High Precision 10 Volt IC Reference



High Precision 10Volt IC Reference
ANALOG DEVICES AD581J is monolithic I.C. which produces a precise 10V (± 13.5mV) with 12 to 40V input. Ideal for many A-D converter applications as well as calibrators, power supplies, etc. 3 terminal package is as easy to use as an ordinary regulator. Can be used as precision current source, can be buffered for very large current outputs. Use as 2 terminal device produces a precision zener.

AD581J (3 terminal TO-5)	$4.98
Specs and Application sheets	.60



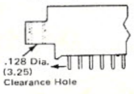
Jumper Kits for .025 Square Posts. All material for making jumpers for quick circuit changes and prototyping. Use for breadboarding, trouble shooting, field modifications. Fits standard IC socket wire/wrap posts. Excellent wiping action on gold plated box contacts.
Kit contain 10 box contacts, heat shrinkable sleeving, and 5 feet of wire plus instruction sheet.
JCK-5101....(5 double jumpers) $2.75, 4 kits/$10.00

CHARACTERISTICS **GOLD**

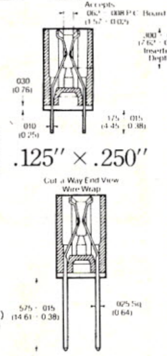
ELECTRICAL

Current Rating (amps)	3
Insulation Resistance (megohms)	5000 min.
Contact Resistance (milliohms)	15 max.
Dielectric Withstanding Voltage (RMS)	1500 min.
Capacitance (picofarads)	2 max.

MECHANICAL FOR .062" (1,57mm) BLADE
Insertion Force:
12 oz./position max.
(3.36 N/position max.)
Withdrawal Force:
2 oz./position min.
(0,56 N/position min.)



MATERIALS
Body Dielectric:
Glass-filled thermoplastic polyester
Color black
Meets U.L. Flammability Classification 94V-0
Contacts:
CA 725 copper-nickel-tin alloy
Gold inlay
Over min. .000100 in. nickel (0,00254 mm.):
Wire Wrap – min. .000050 in. Au (0, 00127 mm.)
Solder Tail – min. .000075 in. Au (0,00190 mm.)
Wire Wrap posts half-hard copper alloy.



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Texas Instruments, world leader in metullurgical technology, is introducing its' new improved H43 connector and TRI-TEK is proud to offer it for the first time to our customers. The H43 represents the best value in the industry on this popular connector style.

Pin grid is designed to fit most of the S-100 bus machines such as Imsai, Vector, Cromemco. Will not fit Altair mother boards.

Heavy gold inlay gives you up to seven times the gold in the cirtical contact area at reduced cost. T.I. has the technology and TRI-TEK has T.I.

Solder tail	H435121-50	$3.59	10/$32.00
Wire wrap	H435111-50	$3.59	10/$32.00

Quantity pricing available

TRI-TEK

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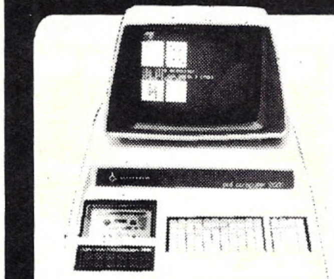

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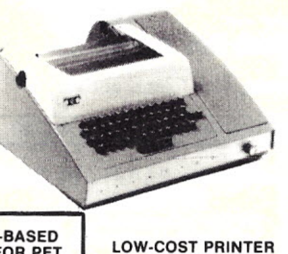

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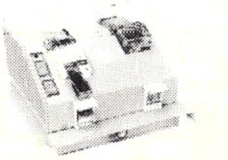

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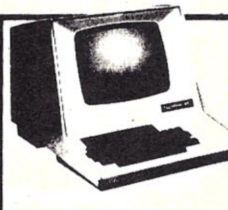

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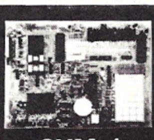

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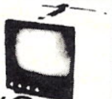

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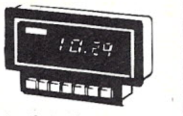

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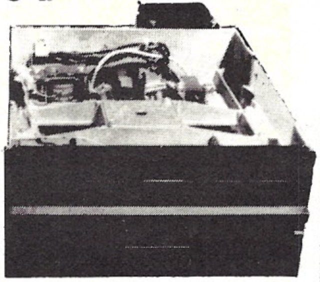

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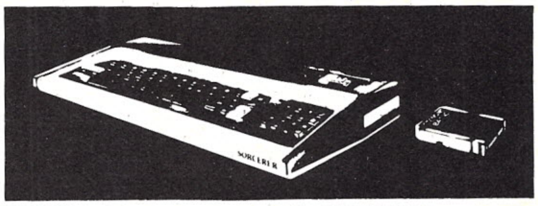

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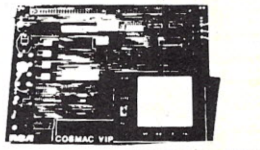

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Shugart SA450 Dual Density Minifloppy	$375.00
Shugart SA800/801 Diskette Storage Drive	$495.00
Shugart SA850/851 Double-Sided Drive	$625.00
MFE Mayflower Model 751 Double Density	$730.00
Persci Model 277 Dual Diskette Storage Drive	$1230.00
Pertec FD200 Miniflop Disk Drive	$299.00
Pertec Model 88 8" Drive	$495.00
Calcomp Model 143M Dual Density Drive	$625.00
North Star MDS Minifloppy w/S-100	$599.00

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LEAR ADM3 Assembled	$829.95
LEAR ADM3 Kit	$739.95
SOROC IQ 140	$1495.00
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Sanyo 15" Monitor	$209.95
Motorola 12" Monitor w/o chassis	$219.95
Hazeltine 1500	$1095.00
Hazeltine 1510	$1295.00

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Metal case for Model 756	$27.00
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1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N4733	5.1v	1 W Zener	.25
1N753A	6.2v	500 mW Zener	.25
1N758A	10v	"	.25
1N759A	12v	"	.25
1N5243	13v	"	.25
1N5244B	14v	"	.25
1N5245B	15v	"	.25

SOCKETS/BRIDGES

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14-pin	pcb	.20	ww	.40
16-pin	pcb	.20	ww	.40
18-pin	pcb	.25	ww	.75
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24-pin	pcb	.35	ww	.95
28-pin	pcb	.45	ww	1.25
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Molex pins	.01	To-3 Sockets	.25
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2N3906	PNP (Plastic - Unmarked)	.10
2N3904	NPN (Plastic - Unmarked)	.10
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2N3055	NPN 15A 60v	.50
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4002	.20
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4008	.75
4009	.35
4010	.35
4011	.20
4012	.20
4013	.40
4014	.75
4015	.75
4016	.35
4017	.75
4018	.75
4019	.35
4020	.85
4021	.75
4022	.75
4023	.20
4024	.75
4025	.20
4026	1.95
4027	.35
4028	.75
4030	.35
4033	1.50
4034	2.45
4035	.75
4040	.75
4041	.69
4042	.65
4043	.50
4044	.65
4046	1.25
4049	.45
4050	.45
4066	.55
4069/74C04	.25
4071	.25
4081	.30
4082	.30
MC 14409	14.50
MC 14419	4.85
4511	.95
74C151	1.90

— T T L —

7400	.10
7401	.15
7402	.15
7403	.15
7404	.10
7405	.25
7406	.25
7407	.55
7408	.15
7409	.15
7410	.15
7411	.25
7412	.25
7413	.25
7414	.75
7416	.25
7417	.40
7420	.15
7426	.25
7427	.25
7430	.15
7432	.20
7437	.20
7438	.20
7440	.20
7441	1.15
7442	.45
7443	.45
7444	.45
7445	.65
7446	.70
7447	.70
7448	.50
7450	.25
7451	.25
7453	.20
7454	.25
7460	.40
7470	.45
7472	.40

7473	.25
7474	.30
7475	.35
7476	.40
7480	.55
7481	.75
7483	.75
7485	.55
7486	.25
7489	1.05
7490	.45
7491	.70
7492	.45
7493	.35
7494	.75
7495	.60
7496	.80
74100	1.15
74107	.25
74121	.35
74122	.55
74123	.35
74125	.45
74126	.35
74132	.75
74141	.90
74150	.85
74151	.65
74153	.75
74154	.95
74156	.70
74157	.65
74161	.55
74163	.85
74164	.60
74165	1.10
74166	1.25
74175	.80

74176	.85
74180	.55
74181	2.25
74182	.75
74190	1.25
74191	.95
74192	.75
74193	.85
74194	.95
74195	.95
74196	.95
74197	.95
74198	1.45
74221	1.00
74367	.75
75108A	.35
75491	.50
75492	.50
74H00	.15
74H01	.20
74H04	.20
74H05	.20
74H08	.35
74H10	.35
74H11	.25
74H15	.45
74H20	.25
74H21	.25
74H22	.40
74H30	.20
74H40	.25
74H50	.25
74H51	.25
74H52	.15
74H53J	.25
74H55	.20

74H72	.35
74H101	.75
74H103	.55
74H106	.95
74L00	.25
74L02	.20
74L03	.25
74L04	.30
74L10	.20
74L20	.35
74L30	.45
74L47	1.95
74L51	.45
74L55	.65
74L72	.45
74L73	.40
74L74	.45
74L75	.55
74L93	.55
74L123	.85
74S00	.35
74S02	.35
74S03	.25
74S04	.25
74S05	.35
74S08	.35
74S10	.35
74S11	.35
74S20	.25
74S40	.20
74S50	.20
74S51	.25
74S64	.15
74S74	.35
74S112	.60
74S114	.65

74S133	.40
74S140	.55
74S151	.30
74S153	.35
74S157	.75
74S158	.30
74S194	1.05
74S257 (8123)	1.05
74LS00	.20
74LS01	.20
74LS02	.20
74LS04	.20
74LS05	.25
74LS08	.25
74LS09	.25
74LS10	.25
74LS11	.25
74LS20	.20
74LS21	.25
74LS22	.25
74LS32	.25
74LS37	.25
74LS38	.35
74LS40	.30
74LS42	.65
74LS51	.35
74LS74	.35
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What do the S-100, the Heath H8, the Radio Shack TRS-80, the Apple, the Digital Group, and the Intel/National 80/10 and 80/20 machines have in common?

Support from CompuKit™

Whether it's flexibility, economy, or reliability that you're looking for, you only need to look to one product line: **CompuKit from Godbout Electronics.** We're the ones who deliver when we say we will, play close attention to the needs of users, and enjoy a doubly enviable reputation for reliability with cost-effectiveness.

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Extended warranty. We believe in our products, and we back them up with a 1 year (not 90 day) limited warranty that covers any defects in materials or workmanship.

Choice of "unkit", assembled and tested, or CSC qualified boards. Most of our memory boards are now available as "unkits", with sockets and bypass caps pre-soldered in place for easy assembly. In addition to standard assembled/tested boards, we also qualify boards under the Certified Systems Components program. These boards are burned in for 200 hours, serial numbered, and guaranteed to run at 4 MHz over the full temperature range. We exchange CSC boards if any defect occurs within 1 year of invoice date.

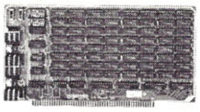
All our Econoram™ memory kits offer the following:

- Extensive bypassing of supply lines
- **Static** design for problem-free interfacing with a variety of systems, and elimination of dynamic timing requirements
- Low power operation with **guaranteed** current specifications
- **All** lines buffered for reliable data transfer
- Write strobe selection switch for S-100 boards (allows use of memory with or without front panel)
- Tri-state outputs for use with bi-directional busses
- Guaranteed under 450 ns access time (conservatively rated; many users are running our boards in 4 MHz Z-80 systems)
- Dip switch address selection and deselection
- High quality, solder masked and legended boards with sockets for all ICs
- S-100 memories are compatible with **all** S-100 machines

CAVE graphx

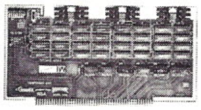
S-100 Products

8K ECONORAM II™ $139 (unkit), $159 (assem)



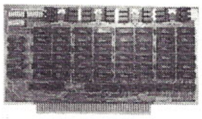
Our least costly way to add memory to S-100 machines. Configured as two independent 4K blocks, with separate protect for each block and vector interrupt provision if you try to write in protected memory. Handles DMA. Less than 1500 mA current consumption.

16K ECONORAM IV™ $279 (unkit), $314 (assm), $414 (CSC)



Manual write protection for 4K blocks, use with or without phantom line, runs DMA at 2 or 4 MHz. Guaranteed under 2000 mA current (typically 1500 mA). Finally . . . static storage at less than the cost of dynamic equivalents!

24K ECONORAM VII™ $445 (unkit), $485 (assm), $605 (CSC)



Our top of the line. Configured as 4 independent blocks (two 8K and two 4K) for unique addressing options. Write protect for each block; use with or without phantom line; provision for two qualifiers; runs DMA at 2 or 4 MHz; draws less than 2500 mA (1800 mA typical).

11 SLOT S-100 MOTHERBOARD

$90 (unkit) Inlcudes all edge connectors pre-soldered in place, with extensive supply line bypassing and active termination for reliable data transfer. Dimensions: 8.5" by 11".

18 SLOT S-100 MOTHERBOARD

$124 (unkit) Same features as above, but 18 slots. Dimensions: 8.5" by 16.7".

Other Computer Products

TRS-80 CONVERSION KIT $159

Expand the TRS-80 mainframe from 4K to 16K, or use with the memory expansion module; our detailed instructions describe both conversion processes. Includes all parts necessary for conversion, and is backed up by our standard 1 year limited warranty. Also suitable for expanding memory in APPLE computers.

12K ECONORAM VI™ $235 (unkit), $270 (assembled)

Same basic features as our S-100 memories, but designed specifically for the Heath H8. Configured as two blocks with switch selected protect. Also includes hardware and edge connector required to mate mechanically with the H8.

32K STATIC S-100 MEMORY: $599!

Full feature "unkit" offers low power comsumption, guaranteed 4 MHz operation . . . and of course, the reliability of an Econoram.

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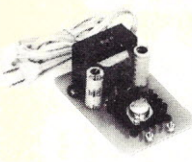

- ★ Uses LM 309K
- ★ Heat sink provided
- ★ P.C. board construction
- ★ Provides a solid 1 amp @ 5V
- ★ Includes components, hardware and instructions
- ★ Sizes: 3-1/2" x 5" x 2" high

JE200 $14.95

Function Generator Kit

- ★ Provides 3 basic waveforms: sine, triangle & square wave
- ★ Frequency range from 1 Hz to 100K Hz
- ★ Output amplitude from 0-volts to over 6 volts (peak to peak)
- ★ Uses a 12V supply or a ± 6V split supply
- ★ Includes chip, P.C. board, components and instructions.

JE2206B $19.95

Digital Stopwatch Kit

- ★ Use Intersil 7205 Chip
- ★ Plated thru double-sided P.C. Board
- ★ LED display (red)
- ★ Times to 59 min. 59.59 sec. with auto reset
- ★ Quartz crystal controlled
- ★ Three stopwatches in one: single event, split (cummulative) and taylor (sequential timing)
- ★ Uses 3 penlite batteries
- ★ Size: 4.5" x 2.15" x .90"

JE900 $39.95

4-Digit Clock Kit

- ★ Bright .357" ht. red display
- ★ Sequential flashing colon
- ★ 12 or 24 hour operation
- ★ Extruded aluminum case (black)
- ★ Pressure switches for hours, minutes and hold modes
- ★ Includes all components, case and wall transformer
- ★ Size: 3-1/4" x 1-3/4" x 1-1/4"

JE730 $14.95

6-Digit Clock Kit

- ★ Bright .300 ht. common cathode display
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 20 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"

JE701 $19.95

Jumbo 6-Digit Clock Kit

- ★ Four .630" ht. and two .300" ht. common anode displays
- ★ Uses MM5314 clock chip
- ★ Switches for hours, minutes and hold functions
- ★ Hours easily viewable to 30 feet
- ★ Simulated walnut case
- ★ 115 VAC operation
- ★ 12 or 24 hour operation
- ★ Includes all components, case and wall transformer
- ★ Size: 6-3/4" x 3-1/8" x 1-3/4"

JE747 $29.95

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CDP1802	CPU	19.95
2650	MPU	19.95
8035	8-Bit MPU w/clock, RAM, 1/0 lines	19.95
P8085	CPU	19.95
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MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
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2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
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2529	Dual 240 Bit Static	4.00
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21L02	1024X1	Static	1.95
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93421	256X1	Static	2.95
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82S123	32X8	Tristate	3.95
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The Sinclair PDM35. A personal digital multimeter for only $59.95

Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment.

The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet they're neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

The Sinclair PDM35 is supplied completely assembled with test leads and prods, protective wallet and Operator's Manual.

The Sinclair PDM35 is tailor-made for anyone who needs to make rapid measurements. Development engineers, field service engineers, lab technicians, computer specialists, radio and electronic hobbyists will find it ideal.

Technical specification

DC Volts (4 ranges)
Range: 1 mV to 1000 V.
Accuracy of reading 1.0% ± 1 count.
Note: 10 MΩ input impedance.

AC Volts (40 Hz-5 kHz)
Range: 1 V to 500 V.
Accuracy of reading: 1.0% ± 2 counts.

DC Current (6 ranges)
Range: 1 nA to 200 mA.
Accuracy of reading: 1.0% ± 1 count.
Note: Max. resolution 0.1 nA.

Resistance (5 ranges)
Range: 1Ω to 20 MΩ.
Accuracy of reading: 1.5% ± 1 count.
Also provides 5 junction-test ranges.

Dimensions: 6 in x 3 in x 1½ in.

Weight: 6½ oz.

Power supply: 9 V battery or Sinclair AC adapter. (Battery not incl.)

Sockets: Standard 4 mm for resilient plugs.

Options: AC adapter for 117 V 60 Hz power. De-luxe padded carrying wallet.

XMAS SPECIAL - Get your PDM-35 PLUS the 117 volt AC Adapter and Padded carrying case for only (Retail value $73.85) $64.50

B+K PRECISION

3½-Digit Portable DMM

- Overload Protected
- 3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage - 0-1000V
AC Voltage: 0-1000V
Freq. Response: 50-400 HZ
DC/AC Current: 0-100mA
Resistance: 0-10 meg ohm
Size: 6.4" x 4.4" x 2"

Model 2800
$99.95

Comes with test leads, operating manual and spare fuse.

Accessories:

AC Adapter BC-28	**$9.00**
Rechargeable Batteries BP-26	**20.00**
Carrying Case LC-28	**7.50**

CSC
CONTINENTAL SPECIALTIES CORPORATION

100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power souces, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

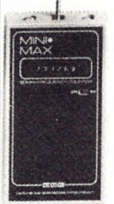
MAX-100 $134.95

ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator use power from car battery	**Model 100 — CLA $3.95**
Charger/Eliminator use 110 V AC	**Model 100 — CAI $9.95**

(New) **CSC**

Mini-Max 6 Digit 50MHz Frequency Counter



- Guaranteed frequency range of 100 Hz to 50 MHz
- Full 6 digit display with antiglare window
- Fully automatic-range, polarity, slope, trigger, input level switching not required.
- Lead-zero blanking—All zeros to the left of the first non-zero digit are blanked. Kilo Hertz and Mega Hertz decimal points automatically light up when the unit is turned on.
- Built in input overvoltage protection.
- Use 9V Battery or 110/220V power.
- Complete with mini antenna.
- Lightweight — Only 8oz.

MINI-MAX $89.95

Accessories For Mini-Max

Part No.	Description	Price
MM-A4	Antenna	$ 3.95
MM-C5	Carrying case	5.95
MM-IPC	Input cable with clip leads	3.95
MM-AC2	110V adapter	9.95
MM-AC3	220V adapter	9.95

$5.00 Minimum Order – U.S. Funds Only
California Residents – Add 6% Sales Tax

Spec Sheets – 25¢
1979 Catalog Available—Send 41¢ stamp

NEW 1979 Catalog

Jameco ELECTRONICS
a division of JAMES ELECTRONICS of California

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good Thru December

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modern and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate	300 Baud.
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space; 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark; High = 025 space, 2225 mark.
Receive Sensitivity	–46 dbm accoustically coupled.
Transmit Level	–15 dbm nominal. Adjustable from –6 dbm to –20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz.
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar).
Power Requirements	120 VAC, single phase, 10 Watts.
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

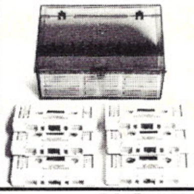
Expand your 4K TRS-80 System to 16K. Kit comes complete with:

* 8 each UPD416 (16K Dynamic Rams)
* Documentation for conversion

TRS-16K $115.00

Special Offer - Order both your TRS-16K and the Sup'R' MOD II Interface kit together (retail value $144.95) **for only $139.95**

COMPUTER CASSETTES



- ★ 6 EACH 15 MINUTE HIGH QUALITY C-15 CASSETTES
- ★ PLASTIC CASE INCLUDED 12 CASSETTE CAPACITY
- ★ ADDITIONAL CASSETTES AVAILABLE #C-15-$2.50 ea

CAS-6
$14.95
(Case and 6 Cassettes)

SUP 'R' MOD II

UHF Channel 33 TV Interface Unit Kit

- ★ Wide Band B/W or Color System
- ★ Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.
- ★ MOD II is pretuned to Channel 33 (UHF).
- ★ Includes coaxial cable and antenna transformer.

MOD II $29.95 Kit

Custom Cables & Jumpers

DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft.	2-DP25S	$17.95 ea.
Dip Jumpers			
DJ14-1	1 ft.	1-14 Pin	$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-16	1 ft.	2-24 Pin	4.95 ea.

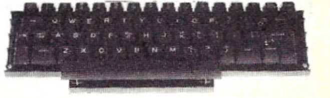
For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

CONNECTORS

25 Pin-D Subminiature

DB25P(as pictured)	PLUG	$2.95
DB25S	SOCKET	3.50
DB51226-1	Cable Cover for DB25 P or S	1.75

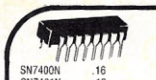
63-Key Unencoded Keyboard



This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK **$29.95/each**

Hexadecimal Unencoded Keypad

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **$10.95/each**



7400 TTL

		SN7470N	.29		
		SN7472N	.29		
SN7400N	.16	SN7473N	.35	SN74160N	.89
SN7401N	.18	SN7474N	.35	SN74161N	.89
SN7402N	.18	SN7475N	.49	SN74162N	1.95
SN7403N	.18	SN7476N	.35	SN74163N	.89
SN7404N	.18	SN7479N	5.00	SN74164N	.89
SN7405N	.20	SN7480N	.50	SN74165N	.89
SN7406N	.29	SN7482N	.99	SN74166N	1.25
SN7407N	.29	SN7483N	.59	SN74167N	1.95
SN7408N	.20	SN7485N	.79	SN74170N	1.59
SN7409N	.20	SN7486N	.35	SN74172N	6.00
SN7410N	.18	SN7489N	1.75	SN74173N	1.25
SN7411N	.25	SN7490N	.45	SN74174N	.89
SN7412N	.25	SN7491N	.59	SN74175N	.79
SN7413N	.40	SN7492N	.43	SN74176N	.79
SN7414N	.70	SN7493N	.43	SN74177N	.79
SN7416N	.25	SN7494N	.65	SN74179N	1.95
SN7417N	.25	SN7495N	.65	SN74180N	.79
SN7420N	.20	SN7496N	.65	SN74181N	1.95
SN7421N	.29	SN7497N	3.00	SN74182N	.79
SN7422N	.39	SN74100N	.89	SN74184N	1.95
SN7423N	.25	SN74107N	.35	SN74185N	1.95
SN7425N	.29	SN74109N	.59	SN74186N	9.95
SN7426N	.29	SN74116N	1.95	SN74188N	3.95
SN7427N	.25	SN74121N	.35	SN74190N	1.25
SN7429N	.39	SN74122N	.39	SN74191N	1.25
SN7430N	.20	SN74123N	.49	SN74192N	.79
SN7432N	.25	SN74125N	.49	SN74193N	.79
SN7437N	.25	SN74126N	.49	SN74194N	.89
SN7438N	.25	SN74132N	.75	SN74195N	.69
SN7439N	.25	SN74136N	.75	SN74196N	.89
SN7440N	.20	SN74141N	.79	SN74197N	.89
SN7441N	.89	SN74142N	2.95	SN74198N	1.49
SN7442N	.49	SN74143N	2.95	SN74199N	1.49
SN7443N	.75	SN74144N	2.95	SN74S200	4.95
SN7444N	.75	SN74145N	.79	SN74251N	1.79
SN7445N	.75	SN74147N	1.95	SN74279N	.79
SN7446N	.69	SN74148N	1.29	SN74283N	2.25
SN7447N	.59	SN74150N	.89	SN74284N	3.95
SN7448N	.79	SN74151N	.59	SN74285N	3.95
SN7450N	.20	SN74152N	.59	SN74365N	.69
SN7451N	.20	SN74153N	.59	SN74366N	.69
SN7453N	.20	SN74154N	.99	SN74367N	.69
SN7454N	.20	SN74155N	.79	SN74368N	.69
SN7459A	.25	SN74156N	.79	SN74390N	1.95
SN7460N	.20	SN74157N	.65	SN74393N	1.95

20% Discount 100 pcs combined order 25% -1000 pcs combined order

C/MOS

CD4000	.23			CD4070	.55
CD4001	.23			CD4071	.23
CD4002	.23	CD4028	.89	CD4072	.49
CD4006	1.19	CD4029	1.19	CD4076	1.39
CD4007	.25	CD4030	.49	CD4081	.23
CD4009	.49	CD4035	.99	CD4082	.23
CD4010	.49	CD4040	1.19	CD4093	.99
CD4011	.23	CD4041	1.25	CD4098	2.49
CD4012	.25	CD4042	.99	MC14409	14.95
CD4013	.39	CD4043	.89	MC14410	14.95
CD4014	1.39	CD4044	.89	MC14411	14.95
CD4015	1.19	CD4046	1.79	MC14419	4.95
CD4016	.49	CD4047	2.50	MC14433	19.95
CD4017	1.19	CD4048	1.35	MC14506	.75
CD4018	.99	CD4049	.49	MC14507	.99
CD4019	.49	CD4050	.49	MC14562	14.50
CD4020	1.19	CD4051	1.19	MC14583	3.50
CD4021	1.39	CD4053	1.19	CD4508	3.95
CD4022	1.19	CD4056	2.95	CD4510	1.39
CD4023	.23	CD4059	9.95	CD4511	1.29
CD4024	.79	CD4060	1.49	CD4515	2.95
CD4025	.23	CD4066	.79	CD4518	1.29
CD4026	2.25	CD4068	.39	CD4520	1.29
CD4027	.69	CD4069	.45	CD4566	2.25

74C00

74C00	.39			74C163	2.49
74C02	.39			74C164	2.49
74C04	.39	74C85	2.49	74C173	2.60
74C08	.49	74C90	1.95	74C192	2.49
74C10	.39	74C93	1.95	74C193	2.49
74C14	1.95	74C95	1.95	74C195	2.49
74C20	.39	74C107	1.25	74C922	5.95
74C30	.39	74C151	2.90	74C923	6.25
74C42	1.95	74C154	3.00	74C925	8.95
74C48	2.49	74C157	2.15	74C926	8.95
74C73	.89	74C160	2.49	80C95	1.50
74C74	.89	74C161	2.49	80C97	1.50

LINEAR

78MG	1.75			LM710N	.79
LM106H	.99			LM711N	.39
LM300H	.80	LM340K-18	1.35	LM723N/H	.55
LM301CN/H	.35	LM340K-24	1.35	LM733N	1.00
LM302H	.75	LM340T-5	1.25	LM739N	1.19
LM304H	1.00	LM340T-6	1.25	LM741CN/H	.35
LM305H	.60	LM340T-8	1.25	LM741-14N	.39
LM307CN/H	.35	LM340T-12	1.25	LM747N/H	.79
LM308CN/H	1.00	LM340T-15	1.25	LM748N/H	.39
LM309H	1.10	LM340T-18	1.25	LM1310N	2.95
LM309K	1.25	LM340T-24	1.25	LM1458CN/H	.59
LM310CN	1.15	LM358N	1.00	MC1488N	1.95
LM311N/H	.90	LM370N	1.95	MC1489N	1.95
LM312H	1.95	LM373N	3.25	LM1496N	.95
LM317K	6.50	LM377N	4.00	LM1556V	1.75
LM318CN/H	1.50	LM380N	1.25	MC1741SCP	3.00
LM319N	1.30	LM380CN	.99	LM2111N	1.95
LM320K-5	1.35	LM381N	1.79	LM2901N	2.95
LM320K-5.2	1.35	LM382N	1.79	LM3053N	1.50
LM320K-12	1.35	NE501N	8.00	LM3065N	1.49
LM320K-15	1.35	NE510A	6.00	LM3900N(3401)	.49
LM320K-18	1.35	NE529A	4.95	LM3905N	.89
LM320K-24	1.35	NE531H/V	3.95	LM3909N	1.25
LM320T-5	1.25	NE536T	6.00	MC5558V	.59
LM320T-5.2	1.25	NE540L	6.00	8038B	4.95
LM320T-8	1.25	NE544N	4.95	LM75450N	.49
LM320T-12	1.25	NE550N	1.30	75451CN	.39
LM320T-15	1.25	NE555V	.39	75452CN	.39
LM320T-18	1.25	NE556N	.99	75453CN	.39
LM320T-24	1.25	NE560B	5.00	75454CN	.39
LM323K-5	5.95	NE561B	5.00	75491CN	.79
LM324N	1.80	NE562B	5.00	75492CN	.89
LM339N	.99	NE565N/H	1.25	75493N	.89
LM340K-5	1.35	NE566CN	1.75	75494CN	.89
LM340K-6	1.35	NE567V/H	.99	RC4136	1.25
LM340K-8	1.35	NE570N	4.95	RC4151	5.95
LM340K-12	1.35	LM703CN/H	.69	RC4194	5.95
LM340K-15	1.35	LM709N/H	.29	RC4195	4.49

74LS00TTL

74LS00	.23			74LS138	.69
74LS01	.23			74LS139	.69
74LS02	.23	74LS47	.69	74LS151	.69
74LS03	.23	74LS51	.23	74LS155	.69
74LS04	.29	74LS54	.23	74LS157	.69
74LS05	.29	74LS55	.23	74LS160	.89
74LS08	.23	74LS73	.35	74LS161	.89
74LS09	.29	74LS74	.35	74LS162	.89
74LS10	.23	74LS75	.49	74LS163	.89
74LS11	.60	74LS76	.35	74LS164	.99
74LS13	.49	74LS78	.39	74LS175	.79
74LS14	.99	74LS83	.75	74LS181	2.49
74LS15	.29	74LS85	.99	74LS190	.89
74LS20	.23	74LS86	.35	74LS191	.89
74LS21	.29	74LS90	.49	74LS192	.89
74LS22	.29	74LS92	.59	74LS193	.89
74LS26	.29	74LS93	.59	74LS194	.89
74LS27	.29	74LS95	.79	74LS195	.89
74LS28	.29	74LS96	.89	74LS253	.79
74LS30	.23	74LS107	.35	74LS257	.69
74LS32	.29	74LS109	.35	74LS258	1.39
74LS37	.35	74LS112	.35	74LS260	.55
74LS40	.29	74LS123	.99	74LS279	.59
74LS42	.69	74LS125	.69	74LS367	.59
		74LS132	.79	74LS368	.59
		74LS136	.39	74LS670	1.95

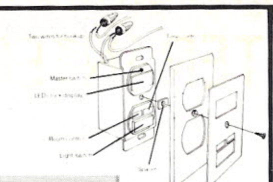
Vigilite

Electronic Home Security Timer

A microprocessor-based pre-programmed light control that fits into a home wall socket, replacing the standard on/off light switch. Discourages intruders and burglars by turning lights on and off in a "real-life" pattern while you're away.

Unlike other electromechanical timers Vigilite can simulate the lighting patterns of five different rooms as selected by the user. Vigilite can also control over-head lights, which other timers cannot. Three Vigilite units, simulating kitchen, bathroom, and bedroom lighting can give a home ultimate protection, because the user chooses a lighting pattern that depicts his real life pattern. He then sets the Vigilite clock and room pattern accordingly. (See bar chart below.) The house actually looks occupied, although no one is home.

Easy to install, the Vigilite unit contains an accurate digital LED clock, plus pre-programmed independent lighting patterns for bedroom, bathroom, kitchen, living room, and outside porch lights. All-solid-state components assure the user long product life and reliablility.



Part Number
VGL-1
$39.95 ea.

Technical Specifications

1) Electrical requirement—120 VAC, 60Hz, 2½ Amps.
2) For use with permanently installed incandescent 40 W to 300 W light fixtures—single pole circuits.
3) Cannot be used to control television, appliances, or other motor driven equipment.
4) One vigilite unit required for each room circuit

DISCRETE LEDS

	.200" dia.			.125" dia.	
XC556R	red	5/$1	XC209R	red	5/$1
XC556G	green	4/$1	XC209G	green	4/$1
XC556Y	yellow	4/$1	XC209Y	yellow	4/$1
XC556C	clear	4/$1			
	.200" dia.			.185" dia.	
XC22R	red	5/$1	XC526R	red	5/$1
XC22G	green	4/$1	XC526G	green	4/$1
XC22Y	yellow	4/$1	XC526Y	yellow	4/$1
	.170" dia.		XC526C	clear	4/$1
MV10B	red	4/$1		.190" dia.	
	.085" dia.		XC111R	red	5/$1
MV50	red	6/$1	XC111G	green	4/$1
			XC111Y	yellow	4/$1
			XC111C	clear	4/$1

INFRA-RED LED
1/4"x1/4"x1/16" flat
5/$1

TIMEX T1001
LIQUID CRYSTAL DISPLAY
FIELD EFFECT

4 DIGIT – .5" CHARACTERS
THREE ENUNCIATORS
2.00" X 1.20" PACKAGE
INCLUDES CONNECTOR

T1001-Transmissive	**$7.95**
T1001A-Reflective	**8.25**

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ± 1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red-D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ± 1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 7G	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 7Y	Common Anode-yellow	.300	.99	DL701	Common Anode-red ± 1	.300	.99
MAN 72	Common Anode-red	.300	.99	DL704	Common Cathode-red	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL707	Common Anode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL728	Common Cathode-red	.500	1.49
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.99	DL746	Common Anode-red ± 1	.630	1.49
MAN 3630	Common Anode-orange ± 1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ± 1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red ± 1	.400	.99	FND358	Common Cathode ± 1	.357	.99
MAN 4740	Common Cathode-red	.400	.99	FND359	Common Cathode	.357	.75
MAN 4810	Common Anode-yellow	.400	.99	FND503	Common Cathode(FND500)	.500	.99
MAN 4840	Common Cathode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D.	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange ± 1	.560	.99	HDSP-3400	Common Anode-red	.800	2.10
MAN 6640	Common Cathode-orange-D.D.	.560	.99	HDSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ± 1	.560	.99	5082-7300	4 x 7 sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D.	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013T	2.15	CA3082N	2.00
CA2023T	2.56	CA3083N	1.60
CA3035T	2.48	CA3086N	.85
CA3039T	1.35	CA3089N	3.75
CA3046N	1.30	CA3130T	1.39
CA3059N	3.25	CA3140T	1.25
CA3060N	3.25	CA3160T	1.25
CA3080T	.85	CA3401N	.49
CA3081N	2.00	CA3600N	3.50

CALCULATOR CHIPS/DRIVERS

MM5725	$2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75
9374 7 seg. C.A. LED driver	1.50

CLOCK CHIPS

MM5309	$4.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387/1998A	4.95
MM5841	9.95

MOTOROLA

MC1408L7	$4.95
MC1408L8	5.75
MC1439L	2.95
MC3022P	2.95
MC3061P	3.50
MC4016(74416)	7.50
MC4024P	3.95
MC4040P	6.95
MC4044P	4.50

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.$17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	$ .37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	$.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	$ .99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100
8 pin SG	$.30	.27	.24
14 pin SG	.35	.32	.29
16 pin SG	.38	.35	.32
18 pin SG	.52	.47	.43
24 pin SG	$ .70	.63	.57
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	$.39	.35	.31
10 pin WW	.45	.41	.37
14 pin WW	.39	.38	.37
16 pin WW	.43	.42	.41
18 pin WW	.75	.68	.62
22 pin WW	$ .95	.85	.75
24 pin WW	1.05	.95	.85
28 pin WW	1.40	1.25	1.10
36 pin WW	1.59	1.45	1.30
40 pin WW	1.75	1.55	1.40

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 OHM 27 OHM	12 OHM 33 OHM	15 OHM 39 OHM	18 OHM 47 OHM	22 OHM 56 OHM	50 PCS	$1.75
ASST. 2	5 ea.	68 OHM 180 OHM	82 OHM 220 OHM	100 OHM 270 OHM	120 OHM 330 OHM	150 OHM 390 OHM	50 PCS	1.75
ASST. 3	5 ea.	470 OHM 1.2K	560 OHM 1.5K	680 OHM 1.8K	820 OHM 2.2K	1K 2.7K	50 PCS	1.75
ASST. 4	5 ea.	3.3K 8.2K	3.9K 10K	4.7K 12K	5.6K 15K	6.8K 18K	50 PCS	1.75
ASST. 5	5 ea.	22K 56K	27K 68K	33K 82K	39K 100K	47K 120K	50 PCS	1.75
ASST. 6	5 ea.	150K 390K	180K 470K	220K 560K	270K 680K	330K 820K	50 PCS	1.75
ASST. 7	5 ea.	1M 2.7M	1.2M 3.3M	1.5M 3.9M	1.8M 4.7M	2.2M 5.6M	50 PCS	1.75

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

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ICM7207	Oscillator Controller	7.50
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ICM7209	Clock Generator	6.95

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TL074CN	Quad Low Noise bi-fet Op Amp	2.49
TL494CN	Switching Regulator	4.49
TL496CP	Single Switching Regulator	1.75
11C90	Divide 10/11 Prescaler	19.95
95H90	Hi-Speed Divide 10/11 Prescaler	11.95
4N33	Photo-Darlington Opto-Isolator	3.95
MK50240	Top Octave Freq. Generator	17.50
DS0026CH	5Mhz 2-phase MOS clock driver	3.75
TIL308	.27" red num. display w/integ. logic chip	10.50
MM5320	TV Camera Sync. Generator	14.95
MM5330	4½ Digit DPM Logic Block	5.95
LD110/111	3½ Digit A/D Converter Set	25.00/set

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XR205	$3.40			XR2242CP	1.50
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XR215	4.40			XR2556	3.20
XR320	1.55			XR2567	2.99
XR-L555	1.50			XR3403	1.25
XR555	.39	XR1800	3.20	XR4136	1.25
XR556	.99	XR2206	4.40	XR4151	2.85
XR567CP	.99	XR2207	3.85	XR4194	1.45
XR567CT	1.25	XR2208	5.20	XR4202	3.60
XR1310P	1.30	XR2209	1.75	XR4212	2.05
XR1468CN	3.85	XR2211	5.25	XR4558	.75
XR1488	1.39	XR2212	4.35	XR4739	1.15
XR1489	1.39	XR2240	3.45	XR4741	1.47

DIODES

TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00
1N751	5.1	400m	4/1.00
1N752	5.6	400m	4/1.00
1N753	6.2	400m	4/1.00
1N754	6.8	400m	4/1.00
1N757	9.0	400m	4/1.00
1N759	12.0	400m	4/1.00
1N959	8.2	400m	4/1.00
1N965	15	400m	4/1.00
1N5232	5.6	500m	28
1N5234	6.2	500m	28
1N5235	6.8	500m	28
1N5236	7.5	500m	28
1N5242	12	500m	28
1N5245	15	500m	28
1N456	25	40m	6/1.00
1N458	150	7m	6/1.00
1N485A	180	10m	5/1.00
1N4001	50 PIV	1 AMP	12/1.00

TYPE	VOLTS	W	PRICE
1N4002	100 PIV	1 AMP	12/1.00
1N4003	200 PIV	1 AMP	12/1.00
1N4004	400 PIV	1 AMP	12/1.00
1N4005	600 PIV	1 AMP	10/1.00
1N4006	800 PIV	1 AMP	10/1.00
1N4007	1000 PIV	1 AMP	10/1.00
1N3600	50	200m	6/1.00
1N4148	75	10m	15/1.00
1N4154	35	10m	12/1.00
1N4305	75	25m	15/1.00
1N4734	5.6	1w	28
1N4735	6.2	1w	28
1N4736	6.8	1w	28
1N4738	8.2	1w	28
1N4742	12	1w	28
1N4744	15	1w	28
1N1183	50 PIV	35 AMP	1.60
1N1184	100 PIV	35 AMP	1.70
1N1185	150 PIV	35 AMP	1.70
1N1186	200 PIV	35 AMP	1.80
1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC.	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC.	1.95

TRANSISTORS

PN2907 Plastic	7/1.00			2N3904	4/1.00
C106B1	.50	MJE3055	1.00	2N3905	4/1.00
MPSA05	.30	2N3392	5/1.00	2N3906	4/1.00
MPSA06	5/1.00	2N3398	5/1.00	2N4013	3/1.00
TIS97	6/1.00	PN3567	3/1.00	2N4123	6/1.00
TIS98	6/1.00	PN3568	4/1.00	PN4249	4/1.00
40409	1.75	PN3569	4/1.00	PN4250	4/1.00
40410	1.75	MPS3638A	5/1.00	2N4400	4/1.00
40673	1.75	MPS3702	5/1.00	2N4401	4/1.00
2N918	4/1.00	2N3704	5/1.00	2N4402	4/1.00
2N2219A	2/1.00	MPS3704	5/1.00	2N4403	4/1.00
2N2221A	4/1.00	2N3705	5/1.00	2N4409	5/1.00
2N2222A	5/1.00	MPS3705	5/1.00	2N5086	4/1.00
2N2369	5/1.00	2N3706	5/1.00	2N5087	4/1.00
2N2369A	4/1.00	MPS3706	5/1.00	2N5088	4/1.00
MPS2369	5/1.00	2N3707	5/1.00	2N5089	4/1.00
2N2484	4/1.00	2N3711	5/1.00	2N5129	5/1.00
2N2906	4/1.00	2N3724A	.65	PN5134	5/1.00
2N2907	5/1.00	2N3725A	1.00	PN5138	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5139	5/1.00
MJE2955	1.25	2N3823	1.00	2N5210	5/1.00
2N3053	2/1.00	2N3903	5/1.00	2N5449	3/1.00
2N3055	.89	PN2222 Plastic	7/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100-	Radial Lead	1-9	10-99	100-
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

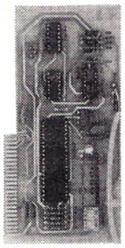
SAVE

COMPUTER INTERFACES & PERIPHERALS

SAVE

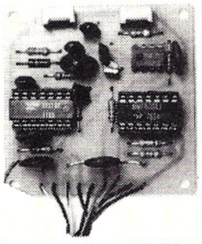
For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

APPLE II SERIAL I/O INTERFACE *



Part no. 2
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — $15.00; with parts — $42.00; assembled and tested — $62.00.

MODEM *

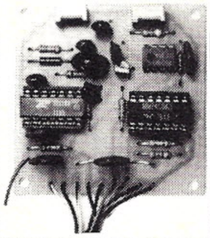


Part no. 109
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board $7.60; with parts $27.50

DC POWER SUPPLY *

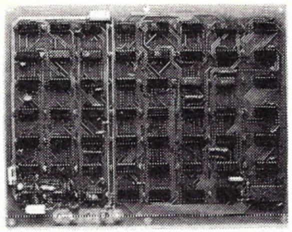
Part no. 6085
• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50; with parts excluding transformers $42.50

TAPE INTERFACE *



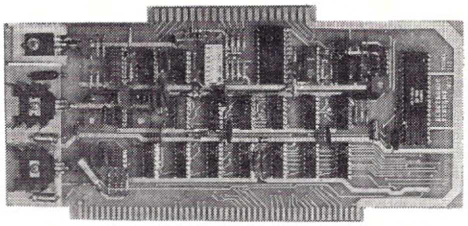
Part no. 111
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board $7.60; with parts $27.50

T.V. TYPEWRITER



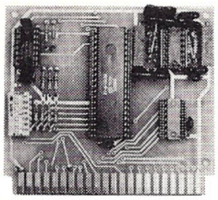
Part no. 106
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps, and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00; with parts $145.00

TIDMA *



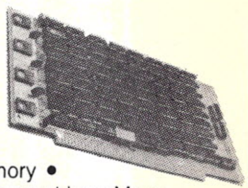
Part no. 112
• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only $35.00; with parts $110.00

UART & BAUD RATE GENERATOR *



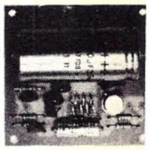
Part no. 101
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00; with parts $35.00 with connector add $3.00

8K STATIC RAM



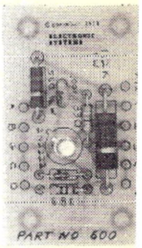
Part no. 300
• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only $22.50; with parts $160.00

RF MODULATOR *



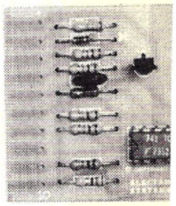
Part no. 107
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommende by Apple. • Power required is 12 volts AC C.T., o +5 volts DC • Board $7.60; with parts $13.50

RS 232/TTY * INTERFACE



Part no. 600
• Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232 • Two separate circuits • Requires +12 and -12 volts • Board only $4.50, with parts $7.00

RS 232/TTL* INTERFACE



Part no. 232
• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edg connector • Board only $4.50; with parts $7.0 with connector add $2.00

ELECTRONIC SYSTEMS Dept. KB, P.O. Box 21638, San Jose, CA. USA 95151

To Order: Mention part number and description. For parts kits add "A" to part number. In USA, shipping paid for orders accompanied by check, money order, o Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for al ICs, components, and circuit board. Documentation is included with all products. All items are in stock, and will be shipped the day order is received vi first class mail. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited 24 Hour Order Line: (408) 226-4064

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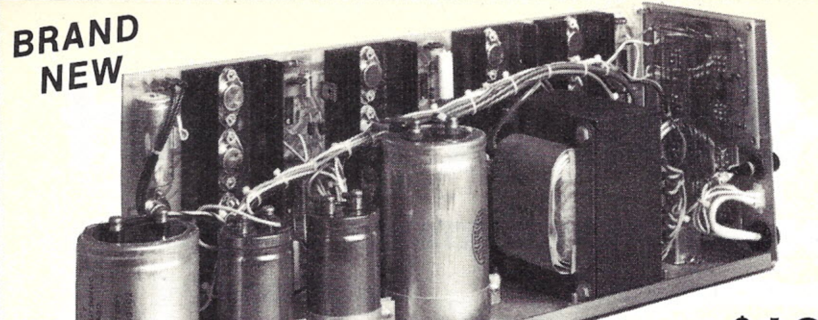

COMPUTER POWER SUPPLY

Output Specifications

under continuous current loads

+ 5 Volts @ 17 Amps ± 2%, 50 mv ripple & noise maximum*

- 5 Volts @ 1.25 Amps ± 5%, 50 mv ripple & noise maximum
+ 12 Volts @ 3 Amps ± 3%, 150 mv ripple & noise maximum
- 12 Volts @ 2.75 Amps ± 3%, 150 mv ripple & noise maximum
+ 24 Volts @ 3.5 Amps ± 5%, 150 mv ripple & noise maximum

* + 5 Volt supply has remote sensing and overvoltage protection

Input

115VAC or 230 VAC, 48-63 Hz, complete with standard 115VAC 3 wire line cord.

ONLY $129.95*

*price includes UPS delivery in the continental US.

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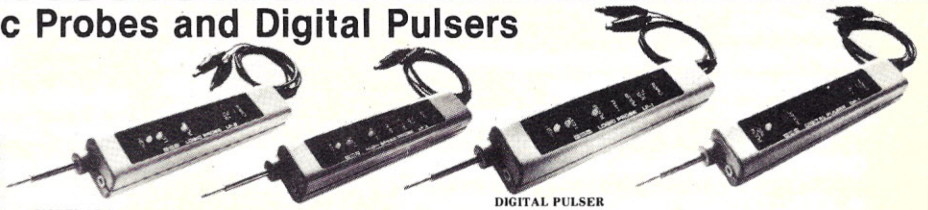
CONTINENTAL SPECIALTIES CORPORATION

CSC

Logic Probes and Digital Pulsers



LOGIC PROBES

CSC logic probes are the ultimate tool for breadboard design and testing. These hand-held units provide an instant overview of circuit conditions. Simple to use; just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic levels and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LEDs tell it quickly, correctly. HI (Logic "1"); LO (Logic "0"). Also incorporates blinking pulse detector. e.g., HI and LO LEDs blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks on for ⅓ second during pulse transition. Choice of three models to meet individual requirements; budget, project and speed of logic circuits.

MODEL LP-1

Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL or CMOS. **Input Impedance:** 100,000 ohms. **Minimum Detectable Pulse:** 50 ns. **Maximum Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

CSC Model LP-1 Logic Probe—Net Each **$44.95**

MODEL LP-2

Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 ohms. **Minimum Detectable Pulse:** 300 ns. **Maximum Input Signal (Frequency):** 1.5 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** None.

CSC Model LP-2 Logic Probe—Net Each **$24.95**

MODEL LP-3

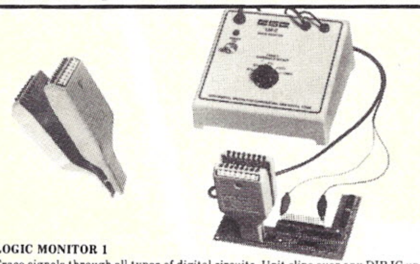
High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 ohms. **Minimum Detectable Pulse:** 10 ns. **Maximum Input Signal (Frequency):** 50 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

CSC Model LP-3 Logic Probe—Net Each **$69.95**

DIGITAL PULSER

The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control push-button; button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, pencil-size lab/field pulse generator for any family of digital circuits. **Output:** Tri-state. **Polarity:** Pulse-sensing auto-polarity. **Sync and Source:** 100 mA. **Pulse Train:** 100 pps. **LED Indicator:** Flashes for single pulse; stays lit for pulse train.

CSC Model DP-1 Digital Pulser—Net Each **$74.95**



LOGIC MONITOR 1

Trace signals through all types of digital circuits. Unit clips over any DIP IC up to 16 pins. Each of its 16 contacts connects to a single-bit level detector that drives a high-intensity, numbered LED readout activated when the applied voltage exceeds a fixed 2 V threshold. Logic "1" turns LED on; logic "0" keeps LED off. A power-seeking gate network automatically locates supply leads and feeds them to the LM-1's internal circuitry. Saves minutes, even hours in design, troubleshooting, debugging of equipment. **Voltage Threshold:** 2 V ± 0.2 V. **Input Impedance:** 100,000 ohms. **Input Voltage Range:** 4-15 V max. across any two or more inputs. **Current Drain:** 200 mA at 10 V. **Size:** 4" l. x 2" w. x 1.75" d. when open. **Weight:** 3 ozs.

CSC Model LM-1 Logic Monitor—Complete. **$59.95**

LOGIC MONITOR 2

Provides greater versatility and precision in testing all types of digital circuits. The fully isolated power supply and selectable trigger threshold let you match the precise characteristics of the logic family under test, permitting more accurate measurements. The connector/display unit clips over any DIP IC up to 16 pins. The power supply module contains the precision reference power supply and logic family selector switch. Operation is simple. Set the threshold switch to the proper logic family. Connect back clip lead to circuit ground. For CMOS circuitry, the red clip is connected to circuit positive or Vcc. The clip module is then clipped over the IC and the LED display instantly gives the logic states of all pins. **Logic Thresholds:** CMOS, 70% of circuit Vcc; HTL., 7.5 V; TTL, 2.4 V: DTL, 1.6 V; RTL, 1.2 V. **Maximum Visible Input Frequency:** 30 KHz at 50% duty cycle. **Size:** Test Clip, 4" l. x 2" w. x 1.75" d. when open; Power Module, 6" w. x 5.63" d. x 3" h. max. **Total Weight:** 20 ozs. **Power Required:** 117 VAC, 50/60 Hz. 10 W; also available for 220 VAC, 50, 60 Hz at slightly higher price.

CSC Model LM-2 Logic Monitor—Complete. **$129.95**

Digital IC Testers and COUNTER

MAX-100 PORTABLE FREQUENCY COUNTER

MAX-100 is a portable, high precision frequency counter that sets new standards in performance and value. In a compact, portable case, it gives you continuous readings from 20 Hz to a guaranteed 100 MHz, with 8-digit accuracy. Fast readings with 1/6-sec. update and 1-sec. sampling rate. Precise readings, derived from a crystal-controlled time base with 3 ppm accuracy. High-sensitivity readings from signals as low as 30 mV, with diode overload protection up to 200 V peaks. Input signals over 100 MHz automatically flash the most significant digit, and to indicate low-battery condition and extend battery life, the entire display flashes at 1 kHz.

SPECIFICATIONS

Frequency Range: 20 Hz to 100 MHz guaranteed: 110 MHz typical. **Gate Time:** 1 sec. **Resolution:** 1 Hz. **Accuracy:** ± 1 count + time base error. **Input Impedance:** 1 megohm shunted by 56 pF. **Coupling:** AC. **Sine Wave Sensitivity:** 30 mV RMS at 50 MHz. **Internal Time Base Frequency:** 3.579545 MHz crystal oscillator.

Stability: ± 3 ppm at 25° C. **Temperature Stability:** Better than 0.2 ppm °C, 0-50° C. Max. **Aging:** 10 ppm year. **Display:** Eight 0.6" LED digits. **Lead-Zero Blanking:** Decimal point appears between 6th and 7th digit when input exceeds 1 MHz. **Overflow:** With signals over 99,999,999 Hz. most significant (left hand) digit flashes, allowing readings in excess of 100 MHz. **Display Update: 1/6-sec. plus 1 sec. gate time. Low Battery Indicator:** When battery supply falls below 6.6 VDC, all digits flash at 1 Hz. **Power Required:** Internal, 6 "AA" cells; external, 110 or 220 VAC charger eliminator, auto cigarette lighter adapter or 7.2-10 VDC external supply. **Battery Charging:** 12-14 hrs. **Size:** 1.75" h. x 5.63" w. x 7.75" d. **Weight:** Less than 1.5 lbs. with batteries.

CSC Model MAX-100 Frequency Counter—Net Each **$134.95**

MAX-100 ACCESSORIES

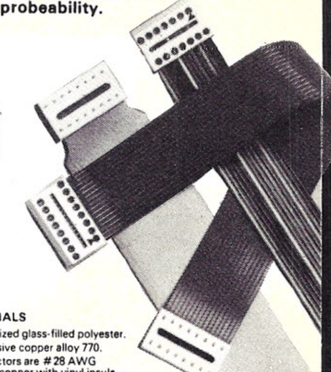
Model 100-CLA—Mobile charger eliminator. Net Each	$ 3.95
Model 100-CA1—110 VAC charger eliminator. Net Each	9.95
Model 100-CA2—220 VAC charger eliminator. Net Each	9.95
Model 100-IPC—Input cable with clip leads. Net Each	5.95
Model 100-LLC—Low-loss tap-off	14.95
Model 100-MWA—Mini-whip antenna	3.95
Model 100-CC—Carry case	9.95

DIP JUMPERS

FLAT RIBBON CABLE ASSEMBLIES WITH DIP CONNECTORS

- **Available with 14, 16, 24 and 40 contacts.**
- **Mate with standard IC sockets.**
- **Fully assembled and tested.**
- **Integral molded-on strain relief.**
- **Line-by-line probeability.**

WOW



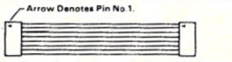
MATERIALS

DIELECTRIC: UL recognized glass-filled polyester.
CONTACTS: Non-corrosive copper alloy 770.
CABLE: All cable conductors are #28 AWG stranded 7/36 tin-coated copper with vinyl insulation. All cable is grooved top and bottom for easy tear down.

A P DIP Jumpers are the low-cost, high-quality solution for jumpering within a PC board; interconnecting between PC boards, backplanes and motherboards; interfacing Input/Output signals; and more.

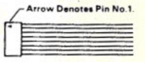
All assemblies use rainbow cable. Standard lengths are 6, 12, 18, 24 and 36 inches.

DOUBLE-ENDED DIP JUMPERS



No. Contacts	Length 6"	Length 12"	Length 18"	Length 24"	Length 36"
14	924106-6-R $2.41	924106-12-R $2.61	924106-18-R $2.82	924106-24-R $3.02	924106-36-R $3.43
16	924116-6-R $2.65	924116-12-R $2.88	924116-18-R $3.11	924116-24-R $3.34	924116-36-R $3.80
24	924126-6-R $4.15	924126-12-R $4.50	924126-18-R $4.85	924126-24-R $5.20	924126-36-R $5.90
40	924136-6-R $6.93	924136-12-R $7.52	924136-18-R $8.11	924136-24-R $8.70	924136-36-R $9.88

SINGLE-ENDED DIP JUMPERS

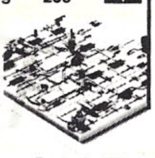


No. Contacts	Length 36"
14	924102-36-R $2.33
16	924112-36-R $2.59
24	924122-36-R $4.00
40	924132-36-R $6.71

ACE • All-Circuit Evaluator

for fast, solderless, plug-in circuit building and testing

Model 236



Just plug in any components with leads to .032" dia. Interconnect with solid wire up to 20 ga. Assembled models too!

ACE Model No.	Tie Points	DIP Capacity	No. Buses	No. Posts	Board Size (inches)	Price Each
200-K (kit)	728	8 (16's)	2	2	4-9/16 x 5-9/16	$18.95
208 (assem.)	872	8 (16's)	8	2	4-9/16 x 5-9/16	28.95
201-K (kit)	1032	12 (14's)	2	2	16 x 7	24.95
212 (assem.)	1224	12 (14's)	8	2	4-9/16 x 7	34.95
218 (assem.)	1760	18 (14's)	10	2	6-1/2 x 7-1/8	46.95
227 (assem.)	2712	27 (14's)	28	4	8 x 9-1/4	59.95
236 (assem.)	3648	36 (14's)	36	4	10-1/4 x 9-1/4	79.95

Gold-anodized aluminum base/ground, non-corrosive nickel-silver terminals, 4 rubber feet

IC TEST CLIPS

TC-14 3 in. $4.50
TC-16 3 in. $4.75

TC-16 fits 14 & 16 Pin Dips.

P21

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OPTO-8000 .1A 10Hz to 600 MHz — FREQUENCY COUNTER

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- Super Sensitivity with preamps in both HI-Z & 50 Ohm inputs <10mV to 50MHz, 25 mV @ 150 MHz <50mV to 600MHz
- Auto Decimal Point ● Aluminum Case ● Socketed IC's
- Three position attenuator: X1, X10, X100 (avoids false counting)

#OPTO-8000.1A	Factory Assembled	$329.95
#OPTO-8000.1AK	Kit Form	$279.95
#NI-CAD-80	NI-CAD Battery Pack	$ 19.95

OPTO-7000 10 Hz to 600 MHz MINIATURE COUNTER

- XTAL (TCXO) Time Base ±.08PPM/°C
- Aluminum Case ● HI-Z & 50 Ohm inputs
- 1 Sec. & 1/10 Sec. Gate times ● Auto Dec. Pt.
- Built-in Prescaler and Preamps Standard

#OPTO-7000	Factory Assembled - 1 Year-Guar	$139.95
#OPTO-7000K	Kit Form	99.95
#AC-70	AC Power Pack	4.95
#NI-CAD-70	NI-CAD Battery Pack	19.95
#TCXO-70	Precision TCXO Time Base <0.1PPM, 17-40°C	79.95

ACCESSORIES

PROBES:

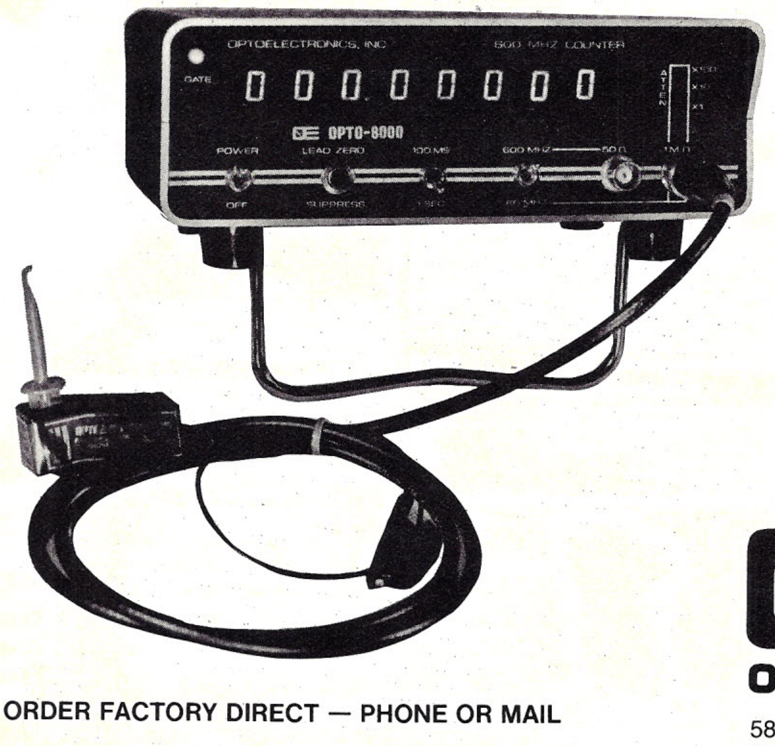
#P-100	50 Ohm, 1X	$13.95
#P-101	Lo-Pass	16.95
#P-102	H1-Z, 2X	16.95

 # AP- 8015 UHF Counter Preamp 20 MHz to 600 MHz 15-50 DB Gain (Not Shown) .. $49.95/Kit $39.95

#D-450 Antenna
Rubber Duck RF Pick-up 450 MHz ... $12.50

#D-146 Same as above
146.5MHz ... $12.50

#RA-BNC Right-Angle BNC Adapter for above Antenna ... 2.95



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AMPEX TAPE We have acquired an inventory of AMPEX 1.0 mil recording tape. These tapes have been used one time by government weather stations. and then we get them. On standard 7" AMPEX reel. ☐ **5588R** .... **$1.75 (4 for $6)**

$24 50 ONLY AT DELTA Burglar ALARM

MOTION DETECTOR

When there is a new development in electronics, it takes some time before that development is available to hobbyists and experimenters, especially at surplus prices. This time we have reversed the trend, and announce a DELTA EXCLUSIVE, the DELTA MOTION DETECTOR. This device detects any motion or movement for a minimum distance of 8-ft. The secret is in the ultra-complex custom LSI chip, which combines the latest in linear & digital circuitry. The device is completely self-contained, in a case 6 x 3 x 2 ¼", and operates from four "AA" NiCad batteries. Nothing else is needed, for the device to perform its basic function, motion detection. When motion or movement is detected, a "whoop" alarm is sounded. The MOTION DETECTOR is designed to provide either an audible or silent alarm. The silent alarm is controlled by a timer, which delays the alarm up to 30 seconds. The silent alarm activates a relay, whose contacts are brought out to plug, and will activate ANY device, such as siren, horn, tape recorder, telephone dialer, etc.

The Motion Detector works on a CHANGE OF LIGHT. Any change of +5% or more, triggers the detector. Works within a range of 0.1 candlepower (almost dark), to 100 candlepower, (quite brite), a range of 1000 to 1. NO external light source is needed.

When left in a darkened or semi-darkened room, the Motion Detector acts as a fantastic FIRE ALARM. The light from a single match, anywhere in the room, triggers the alarm, so that the device becomes an intrusion alarm and fire alarm, all in one.

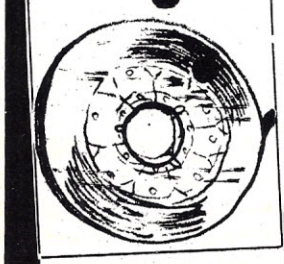
Delta No.	Description	Sale
☐ 5611F	Complete motion detector kit (less batteries	$24.50
☐ 1072F	Motion Detector Chip only, with data	8.95
☐ 5611F	P.C. boards, set of 2	6.50
☐ 5288F	"AA" NiCad Batteries, set of 4	4.50
☐ 5636F	Battery charger for above	5.95
☐ 5635F	Completely assembled kit, w/batteries & charger	69.50

10" REELS 1/8" Computer TAPE!

We have a limited number of 10½" reels of ⅛" computer tape These were used by a large computer manufacturer to test his tape drives. About half of what we have have been used once, and half are unused. These were all certified tapes. They average in length about 3300 feet. Ideal for loading your own cassettes with high quality computer tape. When you order 1 tape, you take your chance of getting new or used tape. More than one will be divided between new and used tape.

#5607F

2/11.00 **5 95**



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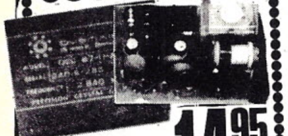
25¢ ea. **5 for $1**

Delta #6508F
HC 18/U-Teflon Posts

PRECISION CRYSTAL OSCILLATOR



2 for $28. **14 95 each**

OVENAIRE

Your computer is only as good as its clock. Delta has been fortunate in acquiring a lot of OVENAIRE precision crystal oscillators, Model OSC 67-11-A-3. Output freq. is 3.840 MHz. The frequency readily divides into many useable frequencies with the use of standard SN7400 series ICs. Among the many frequencies are 640 KHz, 60 KHz, 32 KHz, 20 KHz, 10 KHz, 6 KHz, 1 KHz, 600 Hz, 100 Hz, 60 Hz, 50 Hz, & many more. We provide data showing the Ics needed to get these frequencies. The oscillator is precise to 2 parts per million & is adjustable to even greater precision. Ideal for computers, freq. standards, clocks, etc. This oscillator is a current production item, & the one piece price at the factory is $134.50 (100-lot, $49.80 ez.) so our price of $14.95 each is a fantastic bargain 1⅝ x 2 x ⅝". PC mount. Voltages required are 5 VDC & 12 VDC. Output is TTL compatible 5 VDC. **#5592F**

50-0-50 MICRO AMP DC CENTER READING METER

2 for $25.
$12.95 Each

COMPLETE with 4 scales: (1) +0-1 NA volts, (2) +0-3 MW, (3) 60-120 DB, (4) 10^3 to 10^6 Gain. Meter has a plastic case with removable scale. Size: 4⅛" h x 5½" x 2⅜" d. **#5422 F**

G-E HORIZON LINE TAUT BAND METER

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GE Model 251 — 50 microamp movement. 2 Scales: 20 — 0 - 100 and 0 — 3. 2" mtg. hole. Shielded movement. Distributor's price $33.80; our spectacular price less than 25%. **Delta No. 5643F**

Q-TECH MINIATURE CRYSTAL CONTROLLED CLOCK OSCILLATORS

11.059 MHz

2 FOR $22.
$11.95

Complete crystal oscillator, fits in standard 14 pin DIP socket, TTl compatible, and will drive 10 TTL loads Crystal tolerance is .0005%.

Output "high" is 2.8 volts min. Output is 0.4 max. Vcc is 5 volts. An unusual state of the art device, to provide your computer with a stable, reliable clock source. This oscillator sells for $52.00 in 1 piece lots. Operating frequency is 11,059 MHz. **#1048F**

Crystals

3 95 **All have wire leads!**

2/7.00 **TYPES MARKED (*) $4.95 ea, 2/9.00**

Delta	Freq.	Case
1098F	72 Khz.	-
1013F	116 Khz.	HC-6/u
1016F	158,.4 Khz.	HC-6/u
1026F	290Khz	-
1018F	500Khz.	HC-6/u
1014F	667 Khz.	HC-6/u
1052F	1,536 Mhz.	HC-6/u
1053F	1728 Khz.	HC-6/u
1099F	2,02752 Mhz	-
1015F	3.5 Mhz.	VM-6
1012F	3.8 Mhz.	VM-6
1011F	4.0 Mhz.*	HC-6/u
1008F	5.0 Mhz.*	HC-6/u

High Stability Crystal Oscillator

4.9152 MHz

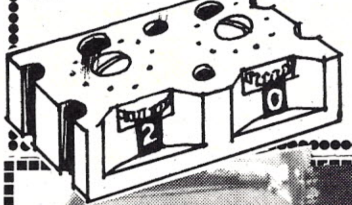
2 for $26.

$13.95

VECTRON CRYSTAL OSCILLATOR Model CO-231T, complete crystal oscillator module, with tuning option, for accuracy of .0001%
Crystal frequency is 4.9152, which divides easily into many frequencies, including 100Hz, 60 Hz, 50Hz, and 1 Hz. We provide data showing the ICs to use to get these frequencies. Current factory price of this module is $75.00 plus $10.00 for the tuning option. TTL compatible. Vcc 5 volts. 1⅜" x 1⅜" **#5581F**

DUAL BINARY ENCODED THUMBWHEEL SWITCH

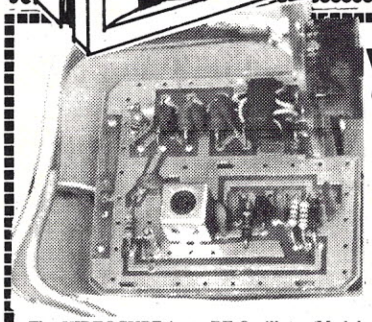
A fortunate purchase enables us to offer the best of both worlds. We have been asked for miniature thumbwheel switches & BCD switches. The BCD switch we are offering is both. The two side-by-side switches measure 1⅝ x ⅜ x⅝", and 0.1" pins for mounting either in P.C. board or Molex terminal. With data.



3 95 ea.

#1096F
2 for $7.

VIDEO CUBE TV INTER FACE



13 95

The VIDEOCUBE is an RF Oscillator/Modulator, which can take as its input a composite video signal, such as the output of a TV game, video camera, or video output of a micro or mini computer, and present it to the atenna terminals of a conventional b & w or color TV set, and displaying the information as if it was a monitor.
The VIDEOCUBE comes with a 300 ohm output, and a selector switch for switching between TV and Videocube. Videocube: 5 to 12 VDC and draws about 10 mils. Meets all FCC requirements for this type of device, and is so certified.
"Complete kit" contains all parts necessary to make an operating Videocube, which includes the p.c. board, the shield, the special switch, special capacitors, coils and balun transformer, plus all resistors, capacitors and diodes. The "partial kit" contains all the hard-to get parts, and you use your own resistors, capacitors & diodes. the kit comes with complete instructions, circuit diagram and assembly drawings, plus a reprint of the article by GLEN DASH, entitles, "THE VERSATILE VIDEOCUBE", appearing in Aug. Radio Electronics.

☐ 5500F	Complete Kit of Parts	$13.95 (2 for $26)
☐ 5500FP	Partial Kit of parts	$11.95 (2 for $22)

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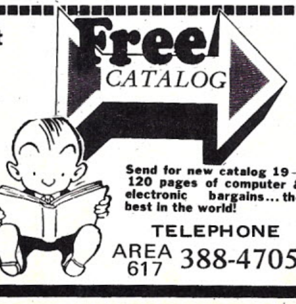

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  The powerful 6502 8-Bit MICROPROCESSOR whose advanced architectural features have made it one of the largest selling "micros" on the market today.
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- 1K BYTES OF 2114 STATIC RAM onboard with sockets provided for immediate expansion to 4K bytes onboard, with total memory expansion to 65, 536 bytes
- USER PROM/ROM: The system is equipped with 3 PROM/ROM expansion sockets for 2316/2332 ROMs or 2716 EPROMs
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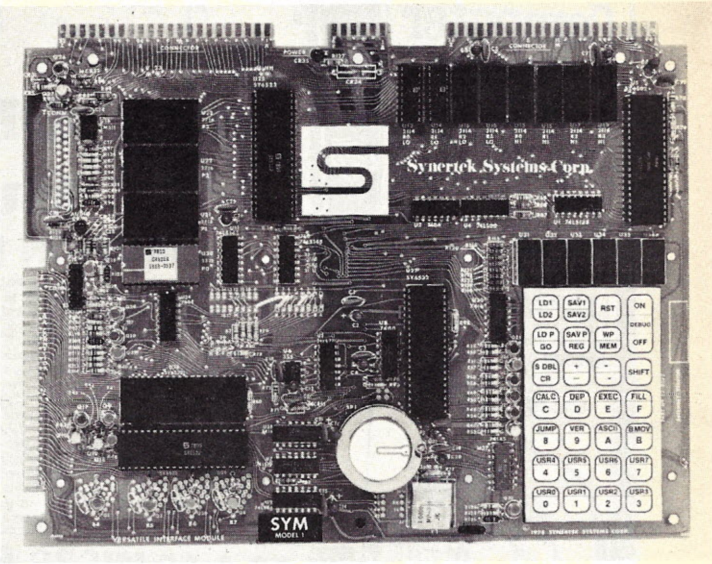
- STANDARD INTERFACES INCLUDE:
  - —Audio Cassette Recorder Interface with Remote Control (Two modes: 135 Baud KIM-1* compatible, Hi-Speed 1500 Baud)
  - —Full duplex 20mA Teletype Interface
  - —System Expansion Bus Interface
  - —TV Controller Board Interface
  - —CRT Compatible Interface (RS-232)
- APPLICATION PORT: 15 Bi-directional TTL lines for user applications with expansion capability for added lines
- EXPANSION PORT FOR ADD-ON MODULES (51 I/O Lines included in the basic system)
- SEPARATE POWER SUPPLY connector for easy disconnect of the d-c power
- AUDIBLE RESPONSE KEYPAD

*KIM is a product of MOS Technology



Synertek has enhanced KIM-1* software as well as the hardware. The software has simplified the user interface. The basic SYM-1 system is programmed in machine language. Monitor status is easily accessible, and the monitor gives the keypad user the same full functional capability of the TTY user. The SYM-1 has everything the KIM-1* has to offer, plus so much more that we cannot begin to tell you here. So, if you want to know more, the SYM-1 User Manual is available, separately.

SYM-1 Complete w/manuals	**$269.00**
SYM-1 User Manual Only	**7.00**
SYM-1 Expansion Kit	**75.00**

Expansion includes 3K of 2114 RAM chips and 1-6522 I/O chip.

SYM-1 Manuals: The well organized documentation package is complete and easy-to-understand

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VAK-1 8-SLOT MOTHERBOARD

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VAK-4 Fully populated 16K RAM	**$379.00**

*KIM is a product of MOS Technology

VAK-5 2708 EPROM PROGRAMMER

This board requires a +5 VDC and +12 VDC, but has a DC to DC multiplyer so there is no need for an additional power supply. All software is resident in on-board ROM, and has a zero-insertion socket.

VAK-5 2708 EPROM Programmer	**$269.00**

VAK-6 EPROM BOARD

This board will hold 8K of 2708 or 2758, or 16K of 2716 or 2516 EPROMs. *EPROMs not included.*

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VAK-7 COMPLETE FLOPPY-DISK SYSTEM (Feb. '79)

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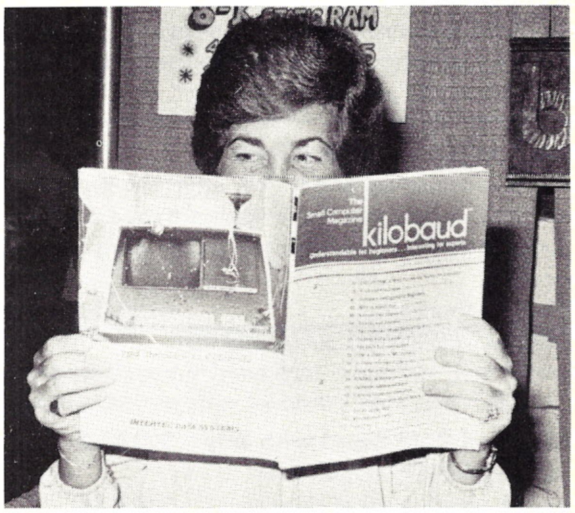

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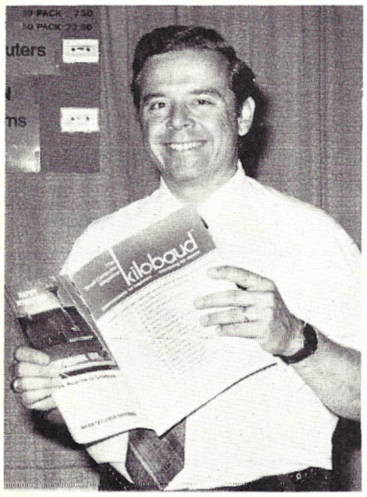

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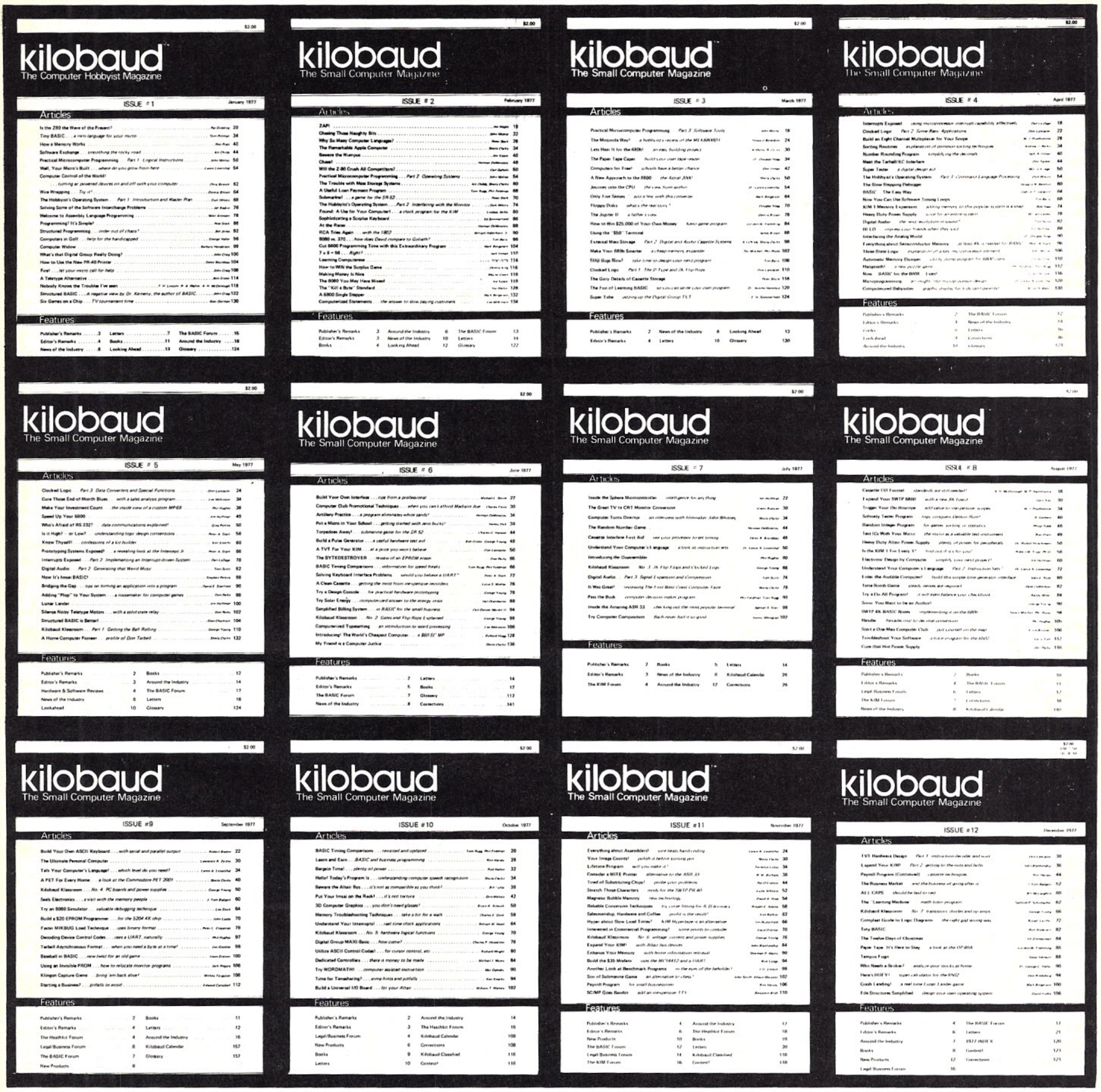

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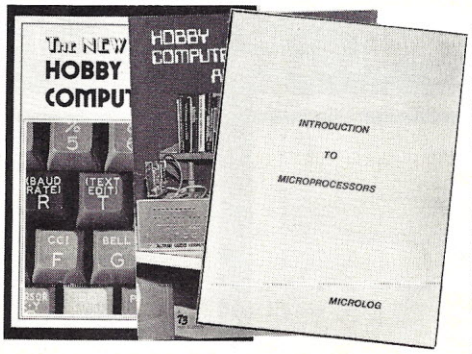

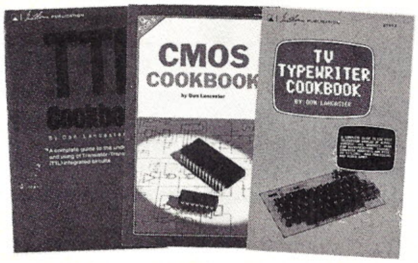

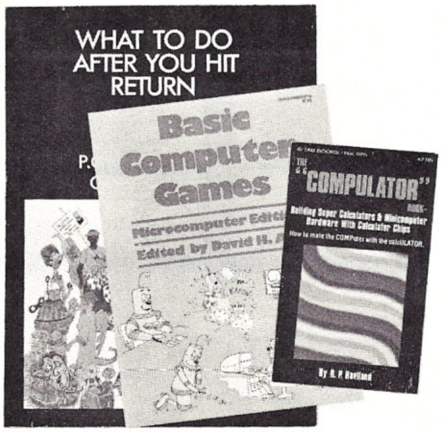

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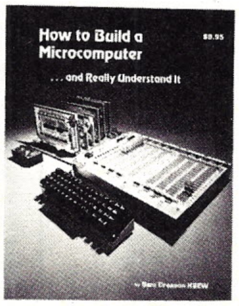

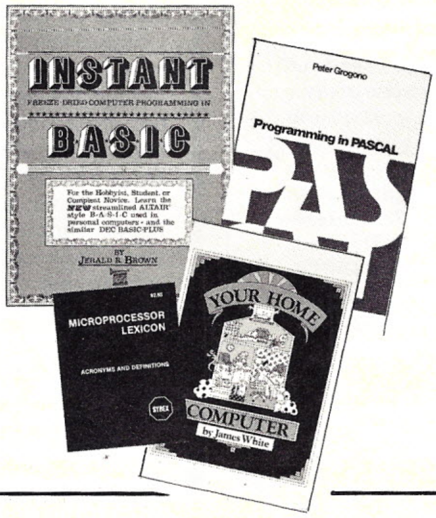

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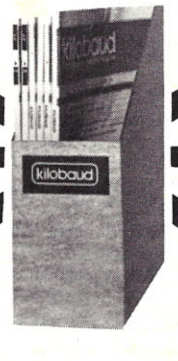

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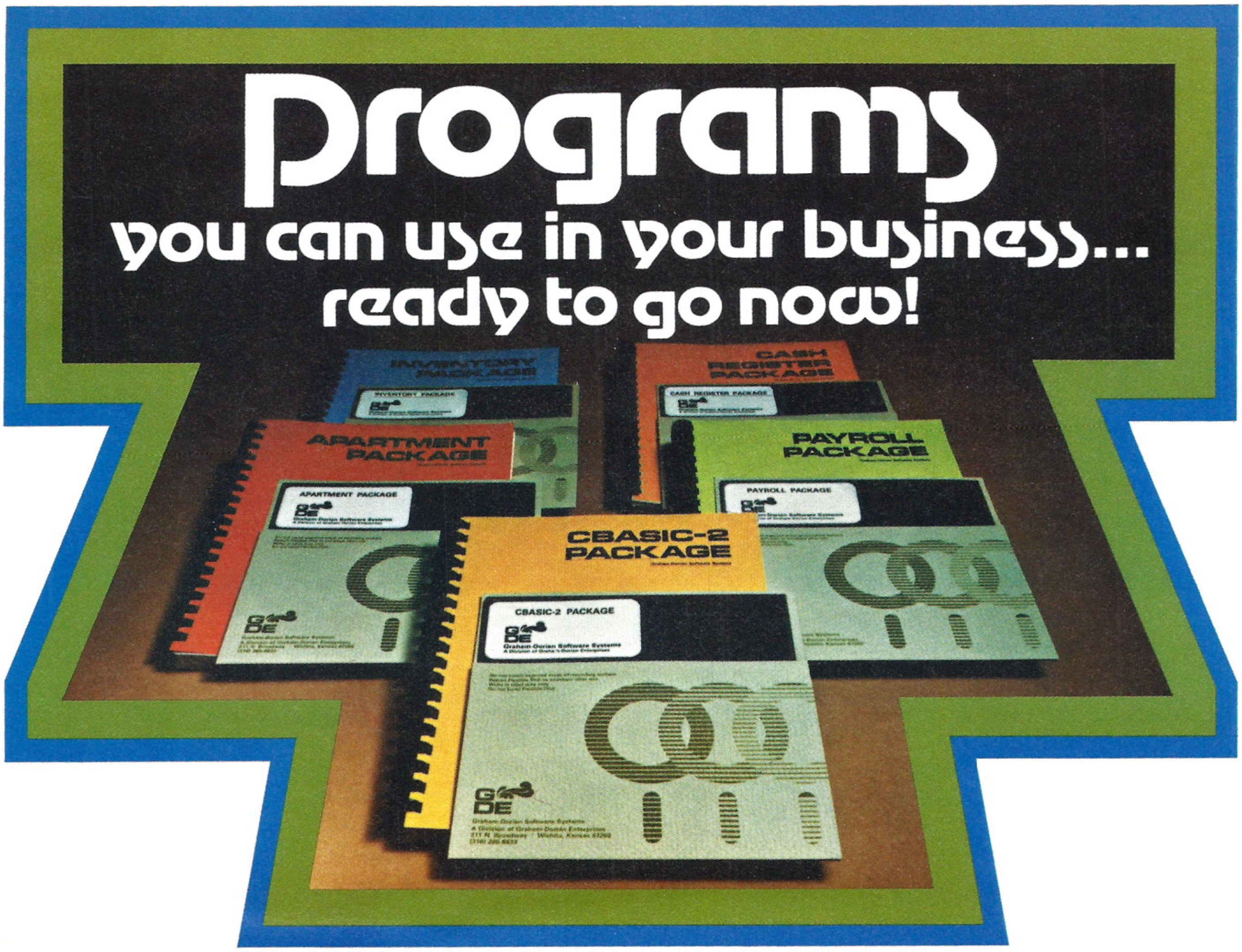

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